(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 May 2016 (19.05.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/075326 A3

(51) International Patent Classification:
C12N 15/82 (2006.01)

(21) International Application Number:
PCT/EP2015/076631

(22) International Filing Date:
13 November 2015 (13.11.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/079,622 14 November 2014 (14.11.2014) US
62/234,373 29 September 2015 (29.09.2015) US

(71) Applicants: **BASF PLANT SCIENCE COMPANY GMBH** [DE/DE]; 67056 Ludwigshafen (DE). **BIORIGINAL FOOD & SCIENCE CORPORATION** [CA/CA]; 102 Melville Street, Saskatoon, Saskatchewan S7J OR1 (CA).

(72) Inventors: **SENGER, Toralf**; 609 Cheselden Drive, Durham, North Carolina 27713 (US). **MARTY, Laurent**; Neue Stücker 21, 69124 Heidelberg (DE). **KUNZE, Irene**; Mühlenweg 11, 06466 Gatersleben (DE). **HAERTEL, Heiko A.**; Rudolf-Reusch-Str. 23D, 10367 Berlin (DE). **BREMMER, Steven**; 1604 Kelvington Place, Apex, North Carolina 27502 (US). **BREAZEALE, Steven**; 462 Neodak Rd., Apex, North Carolina 27523 (US). **BAUER, Jörg**; 1004 Scholastic Circle, Durham, North Carolina 27713 (US). **VRINTEN, Patricia**; 725 310 Stillwater Drive, Saskatoon, Saskatchewan S7J 4H5 (CA). **STYMNE, Sten**; Radmansgatan 1, 26132 Landskrona (SE). **LINDBERG YILMAZ, Jenny**; Per Ols väg 9, 23737 Bfärred (SE). **MCELVER, John**; 5112 Gatewood Dr., Durham, North Carolina 27712 (US). **REIN, Dietrich**; Flottwellstrasse 3a, 10785 Berlin (DE). **ANDRE, Carl**; 1012 Winona Rd, Raleigh, North Carolina 27609 (US).

(74) Agent: **HERZOG FIESSER & PARTNER PATENTANWÄLTE PARTG MBB**; Dudenstraße 46, 68167 Mannheim (DE).

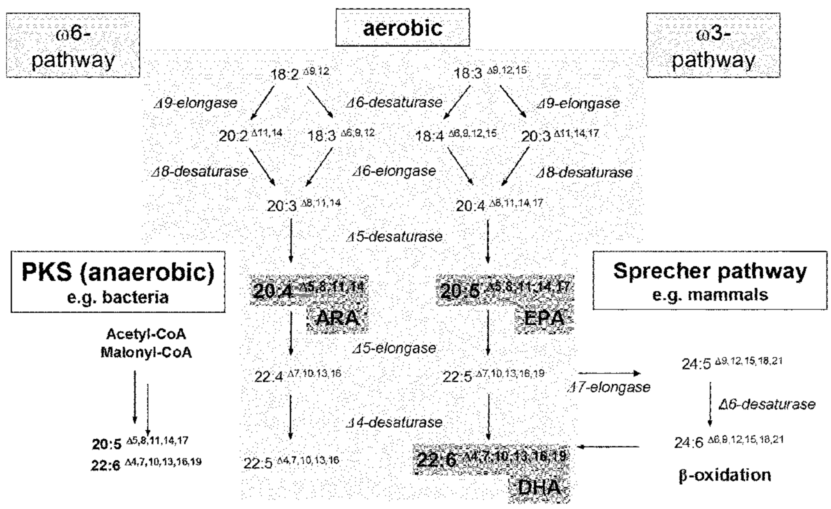
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: MATERIALS AND METHODS FOR PUFA PRODUCTION, AND PUFA-CONTAINING COMPOSITIONS

Fig. 1



(57) Abstract: T-DNA for expression of a target gene in a plant, wherein the T-DNA comprises a left and a right border element and at least one expression cassette comprising a promoter, operatively linked thereto a target gene, and downstream thereof a terminator, wherein the length of the T-DNA, measured from left to right border element and comprising the target gene, has a length of at least 30000 bp.

WO 2016/075326 A3

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

— *with (an) indication(s) in relation to deposited biological material furnished under Rule 13bis separately from the description (Rules 13bis.4(d)(i) and 48.2(a)(viii))*

— *with sequence listing part of description (Rule 5.2(a))*

(88) Date of publication of the international search report:
7 July 2016

MATERIALS AND METHODS FOR PUFA PRODUCTION, AND PUFA-CONTAINING COMPOSITIONS

FIELD OF THE INVENTION

This application claims priority to U.S. Provisional Patent Application Serial Number 62/079622 application number filed November 14, 2014 and to U.S. Provisional Patent Application Serial Number 62/234373 filed September 29, 2015, which are incorporated herein by reference in their entirety.

The Sequence Listing, which is a part of the present disclosure, is submitted concurrently with the specification as a text file via PatentIn version 3.5. The subject matter of the Sequence Listing is incorporated herein in its entirety by reference.

The invention generally pertains to the field of manufacture of fatty acids, particularly for large-scale production of very long chain polyunsaturated fatty acids (VLC-PUFAs, also called polyunsaturated fatty acids or PUFAs), e.g. eicosapentaenoic acid (EPA), omega-3 docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA). The invention particularly is concerned with the production of VLC-PUFAs in plants and thus inter alia provides nucleic acids for transformation of plants to enable such transformed plants to produce VLC-PUFAs. To this end, the invention also provides transgenic constructs and expression vectors containing desaturase and elongase genes and host cells into which the constructs and expression vectors have been introduced. The present invention also relates to methods for the manufacture of oil, fatty acid- or lipids-containing compositions, and to such oils and lipids as such. In addition, the invention is concerned with methods for further improving the production of VLC-PUFAs in plants.

BACKGROUND OF THE INVENTION

Fatty acids are carboxylic acids with long-chain hydrocarbon side groups that play a fundamental role in many biological processes. Fatty acids are rarely found free in nature but, rather, occur in esterified form as the major component of lipids. As such, lipids/fatty acids are sources of energy (e.g., beta-oxidation). In addition, lipids/fatty acids are an integral part of cell membranes and, therefore, are indispensable for processing biological or biochemical information.

Long chain polyunsaturated fatty acids (VLC-PUFAs) such as docosahexaenoic acid (DHA, 22:6(4,7,10,13,16,19)) are essential components of cell membranes of various tissues and organelles in mammals (nerve, retina, brain and immune cells). Clinical studies have shown that DHA is essential for the growth and development of the brain in infants, and for maintenance of normal brain function in adults (Martinetz, M. (1992) J. Pediatr. 120:S129 S138). DHA also has significant effects on photoreceptor function involved in the signal transduction process, rhodopsin activation, and rod and cone development (Giusto, N.M., et al. (2000) Prog. Lipid Res. 39:315-391). In addition, some positive effects of DHA were also found on diseases such as hypertension, arthritis, atherosclerosis, depression, thrombosis and cancers (Horrocks, L.A. and

Yeo, Y.K. (1999) Pharmacol. Res. 40:211-215). Therefore, appropriate dietary supply of the fatty acid is important for human health. Because such fatty acids cannot be efficiently synthesized by infants, young children and senior citizerns, it is particularly important for these individuals to adequately intake these fatty acids from the diet (Spector, A.A. (1999) Lipids 34:S1 S3). EPA (20:5n-3 5,8,11,14,17) and also ARA (arachidonic acid, 20:4n-6 (5,8,11,14)) are both delta 5 (d5) essential fatty acids. They form a unique class of food and feed constituents for humans and animals. EPA belongs to the n-3 series with five double bonds in the acyl chain. EPA is found in marine food and is abundant in oily fish from North Atlantic. ARA belongs to the n-6 series with four double bonds. The lack of a double bond in the omega-3 position confers on ARA different properties than those found in EPA. The eicosanoids produced from ARA (sometimes abbreviated “AA”) have strong inflammatory and platelet aggregating properties, whereas those derived from EPA have anti-inflammatory and anti-platelet aggregating properties. ARA can be obtained from some foods such as meat, fish and eggs, but the concentration is low.

Gamma-linolenic acid (GLA, C18:3n-6 (6,9,12)) is another essential fatty acid found in mammals. GLA is the metabolic intermediate for very long chain n-6 fatty acids and for various active molecules. In mammals, formation of long chain polyunsaturated fatty acids is rate-limited by delta-6 desaturation. Many physiological and pathological conditions such as aging, stress, diabetes, eczema, and some infections have been shown to depress the delta-6 desaturation step. In addition, GLA is readily catabolized from the oxidation and rapid cell division associated with certain disorders, e.g., cancer or inflammation. Therefore, dietary supplementation with GLA can reduce the risks of these disorders. Clinical studies have shown that dietary supplementation with GLA is effective in treating some pathological conditions such as atopic eczema, premenstrual syndrome, diabetes, hypercholesterolemia, and inflammatory and cardiovascular disorders.

A large number of benefitial health effects have been shown for DHA or mixtures of EPA and DHA.

Although biotechnology offers an attractive route for the production of specialty fatty acids, current techniques fail to provide an efficient means for the large scale production of unsaturated fatty acids. Accordingly, there exists a need for an improved and efficient method of producing very long chain poly unsaturated fatty acids (VLC-PUFAs), such as EPA and DHA.

The current commercial source of EPA and DHA is fish oil. However, marine stocks are diminishing as a result of over-fishing, and alternative sustainable sources of EPA and DHA are needed to meet increasing demand. Numerous efforts have been made to develop transgenic oilseed plants that produce VLC-PUFAs, including EPA and DHA. See, e.g., WO 2004/071467, WO 2013/185184, WO 2015/089587, Ruiz-Lopez, et al. (2014) Plant J. 77, 198-208. However, no transgenic oilseed plant has been commercialized which produces EPA and DHA at commercially relevant levels.

To make possible the fortification of food and/or of feed with polyunsaturated omega-3-fatty acids, there is still a great need for a simple, inexpensive process for the production of each of the aforementioned long chain polyunsaturated fatty acids, especially in eukaryotic systems.

SUMMARY OF THE INVENTION

The invention is thus concerned with providing a reliable source for easy manufacture of VLC-PUFAs. To this end the invention is also concerned with providing plants reliably producing VLC-PUFAS, preferably EPA and/or DHA. The invention is also concerned with providing means and methods for obtaining, improving and farming such plants, and also with VLC-PUFA containing oil obtainable from such plants, particularly from the seeds thereof. Also, the invention provides uses for such plants and parts thereof.

According to the invention there is thus provided a T-DNA for expression of a target gene in a plant. The invention beneficially provides a system for transformation of plant tissue and for generation of recombinant plants, wherein the recombinant plant differs from the respective parental plant (for the purposes of the present invention the parental plant is termed a wild-type plant regardless of whether or not such parental plant is as such found in nature) by the introduction of T-DNA. The T-DNA introduced into the parental plant beneficially has a length of at least 30000 nucleotides.

The invention also provides plants with a genotype that confers a heritable phenotype of high seed oil VLC-PUFA content in one or more of their tissues or components, preferably a high content of EPA and/or DHA in seed oil. The invention further provides material comprising a high VLC-PUFA content relative to their total oil content, preferably a high content of EPA and/or DHA. Also, the invention provides exemplary events of Brassica plants. Most beneficially the invention provides oil comprising a high VLC-PUFA content, preferably a high content of EPA and/or DHA.

The invention also provides methods of producing an oil, wherein the oil has a high VLC-PUFA content, a high content of EPA and/or DHA. In particularly preferred aspects these methods are for producing a corresponding plant oil. Thus, invention also provides methods of producing an oil.

The invention also provides methods for creating a plant, such that the plant or progeny thereof can be used as a source of an oil, wherein the oil has a high VLC-PUFA content, a high content of EPA and/or DHA. Thus, the invention beneficially also provides methods for the production of plants having a heritable phenotype of high seed oil VLC-PUFA content in one or more of their tissues or components, preferably a high content of EPA and/or DHA in seed oil.
The present invention also provides a method for increasing the content of Mead acid (20:3n-9) in a plant relative to a control plant, comprising expressing in a plant, at least one polynucleotide encoding a delta-6-desaturase, at least one polynucleotide encoding a delta-6-elongase, and at least one polynucleotide encoding a delta-5-desaturase.

The invention also provides means for optimizing a method for creating plants according to the invention. In this respect, the invention provides a system of methods for analyzing enzyme specificities, particularly for analyzing desaturase reaction specificity and for analyzing elongase specificities, for optimization of a metabolic pathway and for determining CoA-dependence of a target desaturase.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1: Schematical figure of the different enzymatic activities leading to the production of ARA, EPA and DHA

Figure 2: Formulas to calculate pathway step conversion efficiencies. S: substrate of pathway step. P: product of pathway step. Product was always the sum of the immediate product of the conversion at this pathway step, and all downstream products that passed this pathway step in order to be formed. E.g. DHA (22:6n-3 does possess a double bond that was a result of the delta-12-desaturation of oleic acid (18:1n-9) to linoleic acid (18:2n-6).

Figure 3: Strategy employed for stepwise buildup of plant expression plasmids of the invention.

Figure 4: Stabiliy of binary plant expression plasmids containing the ColE1/pVS1 origin of replication for plasmid recplication in E.coli/Agrobacteria. Left Panel: Stability in Agrobacterium cells by isolating plasmid DNA from Agrobacterium cutures prior to usage of this culture for plant transformation, and subjecting the plasmid DNA to a restriction digest. An unexpected restriction pattern indicates disintegration/instability of the plasmid either in E.coli or in Agrobacterium. Right panel: Under the assumption at least one intact T-DNA from LB to RB was integrated into the plant genome during the transformation process most plants obtained via transformation of a given plasmid are expected to reach the desired trait encoded by the plasmid (here: production of novel fatty acids (FA) in the seeds). The decrease in the percentage of such ‘functional’ plants indicates instability either in Agrobacteria or during the transfer process into the plant or during the integration process into the genome. As can be seen, the proportion of non functional plants goes sharply up for plasmids above 25,000bp size when ColE1/pVS1 containing plasmids are used.

Figure 5: Plasmid map of VC-LJB2197-1qcz indicating the position of genetic elements listed in table 1.

Figure 6: Plasmid map of VC-LJB2755-2qcz rc indicating the position of genetic elements listed in table 2.

Figure 7: Plasmid map of VC-LLM306-1qcz rc indicating the position of genetic elements listed in table 3.

Figure 8: Plasmid map of VC-LLM337-1qcz rc indicating the position of genetic elements listed in table 4.

Figure 9: Plasmid map of VC-LLM338-3qcz rc indicating the position of genetic elements listed in table 5.

Figure 10: Plasmid map of VC-LLM391-2qcz rc indicating the position of genetic elements listed in table 6.

Figure 11: Plasmid map of VC-LTM217-1qcz rc indicating the position of genetic elements listed in table 7.

Figure 12: Plasmid map of RTP10690-1qcz_F indicating the position of genetic elements listed in table 8.

Figure 13: Plasmid map of RTP10691-2qcz indicating the position of genetic elements listed in table 9.

Figure 14: Plasmid map of LTM595-1qcz rc indicating the position of genetic elements listed in table 10.

Figure 15: Plasmid map of LTM593-1qcz rc indicating the position of genetic elements listed in table 11.

Figure 16: Comparative transcript analysis o3Des(Pi_GA2) driven by the VfUSP promoter during seed development of single copy event of four different construct combinations.

Figure 17: Comparative transcript analysis of o3Des(Pir_GA) during seed development of single copy event of four different construct combinations. In VC-LJB2755-2qcz and VC-RTP10690-1qcz_F the gene was driven by the LuCnl promoter while in VC-LLM337-1qcz rc the gene was driven by the VfUSP promoter and was expressed at a lower level than the LuCnl o3Des(Pir_GA) combination.

Figure 18: Comparative transcript analysis of o3Des(Pir_GA) driven by the BnSETL promoter during seed development of single copy event of VC-RTP10690-1qcz_F.

Figure 19: Comparative transcript analysis of d4Des(Pl_GA)2 driven by the LuCnl promoter during seed development of single copy event from VC-RTP10690-1qcz_F and VC-LTM217-1qcz rc, which was present with VC-LJB2755-1qcz. The other constructs lacked this particular d4Des.

Figure 20: Comparative transcript analysis of d4Des(Tc_GA) driven by the ARC5 promoter during seed development of single copy event of four different construct combinations.

Figure 21: Comparative transcript analysis of d4Des(Eg_GA) driven by the LuCnl promoter during seed development of single copy event of two different construct combinations; VC-LJB2755-2qcz, VC-LLM391-2qcz rc and VC-LJB2197-1qcz, VC-LLM337-1qcz rc.

Figure 22: Half Kernel Analysis of segregating T1 seeds of Event LANPMZ. A total of 288 seedlings where analysed. 71 of those seedlings were found to produce no significant amount of VLC-PUFA (dark grey diamonds) while containing >49% Oleic acid and <28% Linoleic acid. 71 seed of 288 seed correspond to 24.65% of the total analysed seed. All remaining seed were capable of producing DHA, indicating the presence of both T-DNA from construct VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Among those seeds producing DHA, one can discriminate a group of 146 seeds showing medium VLC-PUFA levels (open diamonds), and a group of 71 seed showing high VLC-PUFA levels (light grey diamonds). The ratios of these three groups is 71:146:71, which corresponds to the Medelain 1:2:1 ratio (NULL:HETEROZYGOUS:HOMOZYGOUS) expected for a phenotype when all genes conveying this phenotype (in this case the two T-DNAs of plasmid VC-LJB2197-1qcz and VC-LLM337-1qcz rc) integrated into one locus in the genome.

Figure 23: Half Kernel Analysis of segregating T1 seeds of Event LBDIHN. A total of 288 seedlings where analysed. The levels of first substrate fatty acid of the pathway was plotted on the x-axis, the levels of the sum of two products of the pathways (EPA+DHA) was plotted on the y-axis. One can clearly see three clusters, where the ratio of the number of seeds in the these three clusters was 1:2:1 (Homozygous:Heterozygous:Null segregant). This segregation of the phenotype according to the first Mendelian law demonstrates a single locus insertion of the T-DNA of construct RTP10690-1qcz_F into the genome of B.napus cv Kumily.

Figure 24: Examples of Desaturase Enzyme Activity Heterologously Expressed in Yeast. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions, resolved by TLC as described for each specific enzyme and detected by electronic autoradiography using Instant Imager. In panel A Delta-12 Desaturase (Ps), c-d12Des(Ps_GA), activity was demonstrated by comparison of enzyme activity present in yeast microsomes isolated from a strain expressing the c-d12Des(Ps_GA) protein relative to microsomes isolated from a control strain containing an empty vector (VC). In panel B Omega-3 Desaturase activities, c-o3Des(Pir_GA) and c-o3Des(Pi_GA2), activities were demonstrated by comparison of enzyme activity from yeast microsomes isolated from strains expressing c-o3Des(Pir_GA) protein, c-o3Des(Pi_GA2) protein or an empty vector (VC) control. In panel C Delta-4 Desaturase (Tc), c-d4Des(Tc_GA), activity was demonstrated by comparison of enzyme activity from yeast microsomes isolated from a strain expressing the c-d4Des(Tc_GA) protein relative to microsomes isolated from a control strain containing an empty vector (VC). In panel D Delta-4 Desaturase (Pl), c-d4Des(Pl_GA)2, activity was demonstrated by comparison of enzyme activity from yeast microsomes isolated from a strain expressing the c-d4Des(Pl_GA)2 protein relative to microsomes isolated from a control strain containing an empty vector (VC).

Figure 25: Examples of Desaturase Enzyme Activity in transgenic Brassica napus. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions, resolved by TLC as

described for each specific enzyme and detected by electronic autoradiography using Instant Imager. In panel A Delta-12 Desaturase (Ps), c-d12Des(Ps_GA), activity was demonstrated by comparison of enzyme activity from yeast microsomes isolated from a strain expressing the c-d12Des(Ps_GA) protein relative to microsomes isolated from transgenic B. napus containing the d12Des(Ps_GA2) gene. In panel B Delta-4 Desaturase (Tc), c-d4Des(Tc_GA), and Delta-4 Desaturase (Pl) activities were demonstrated by comparison of enzyme activity from yeast microsomes isolated from a strain expressing the c-d4Des(Tc_GA) protein relative to microsomes isolated from transgenic B. napus containing the d4Des(Tc_GA3) and d4Des(Pl_GA)2 genes.

Figure 26: Examples of Desaturase Enzyme Reactions Showing Specificity for Acyl-lipid substrates. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions containing microsomes obtained from a yeast strain expressing the protein of interest, resolved by TLC as described for each specific enzyme and detected by electronic autoradiography using Instant Imager. In panel A Delta-12 Desaturase (Ps), c-d12Des(Ps_GA), desaturated enzyme products were only detected in the phosphatidylcholine fraction indicating the enzyme was specific for an acyl-lipid substrate. In panel B and panel C Delta-4 Desaturase (Tc), c-d4Des(Tc_GA), desaturated enzyme products were detected in the phosphatidylcholine fraction indicating the enzyme was specific for an acyl-lipid substrate. In panel D a time-course demonstrates the activity of the Delta-4 Desaturase (Tc), c-d4Des(Tc_GA).

Figure 27: Examples of Desaturase Enzyme Reactions Showing Specificity for Acyl-CoA substrates. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions containing microsomes obtained from a yeast strain expressing the protein of interest, resolved by TLC as described for each specific enzyme and detected by electronic autoradiography using Instant Imager. In panel A PC was in situ labeled with substrate according to the method for determining lipid linked desaturation. Delta-9 Desaturase (Sc), d9D(Sc), desaturated enzyme products were very low in the phosphatidylcholine fraction, except for in the control reaction (none in situ labeled PC), indicating the enzyme cannot desaturate an acyl-lipid substrate. In panel B and C the incubation was done according to the method for determining acyl-CoA linked desaturation. In panel B the amount of radioactivity in the acyl-CoA fraction (MeOH/H2O-phase, called nmol 16:1 in H20) was increasing when 20:1-CoA was added to the assay. This indicates that the added 20:1-CoA was competing with the radioactive substrate in formation of PC and free fatty acids. In panel C the amount of desaturated enzyme products was increased in the acyl-CoA fraction when 20:1-CoA was added to the assay, indicating that the desaturation was acyl-CoA linked.

Figure 28: Examples of Elongase Enzyme Activity Heterologously Expressed in Yeast. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions, resolved by TLC as described for each specific enzyme and detected by electronic autoradiography using Instant Imager. All FAME's shown had similar Rf's as authentic standards. In the absence of [14C]malonyl-CoA no radioactive fatty acids were observed in any of these elongase reactions. In panel A delta-6 elongase (Tp), c-d6Elo(Tp_GA2), activity was demonstrated by comparison of enzyme activity present in yeast microsomes isolated from a strain expressing the c-

d6Elo(Tp_GA2) protein relative to microsomes isolated from a control strain containing an empty vector (VC). In panel B, delta-6 elongase (Pp), c-d6Elo(Pp_GA2), was demonstrated by comparison of enzyme acitivity from yeast microsomes isolated from a strains expressing c-d6Elo(Pp_GA2) protein to microsomes isolated from a control strain containing an empty vector (VC), as shown in panel A. In panel C, delta-5 elongase (Ot), c-d5Elo(Ot_GA3), activity was demonstrated by comparison of enzyme activity present in yeast microsomes isolated from a strain expressing the d5E(Ot) protein relative to microsomes isolated from a control strain containing an empty vector (VC).

Figure 29: Examples of Elongase Activity in transgenic Brassica napus. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions, resolved by TLC as described for each specific enzyme and detected by electronic autoradiography using Instant Imager. In panel A Delta-6 Elongase activity was demonstrated by comparison of enzyme activity from yeast microsomes isolated from a strain expressing the d6E(Pp_GA2) protein relative to microsomes isolated from transgenic B. Napus containing the c-d6Elo(Pp_GA2) gene and the c-d6Elo(Tp_GA2) gene. In panel B the Delta-5 Elongase (Ot), d5Elo(Ot_GA3), activity was demonstrated by comparison of enzyme activity from yeast microsomes isolated from a strain expressing the c-d5Elo(Ot_GA3) protein relative to microsomes isolated from transgenic B. Napus containing the d5Elo(Ot_GA3) and a wild-type B. napus (control).

Figure 30: Time course optimization.Yeast cells expressing the c-d5Des(Tc_GA2) were fed with 0.25 mM DHGLA and the production of ARA was determined by GC. Samples were collected starting immediately after feeding. In Panels A-D, Desaturation was represented as %Conversion vs Growth Time (hours) and Product and Substrate levels are represented as %Total Fatty acid vs Growth time (hours). Panel A pertains to samples supplied with DHGLA immediately after induction. Panel B is overnight induction (22hrs) before feeding. Panel C is for cultures supplied with 3X normal DHGLA level. Panel D is for cultures supplied with normal rate of DHGLA (0.25 mM) daily.

Figure 31: Representative time course graphs for all desaturases and elongases. Yeast cells expressing each enzyme were supplied with 0.25 mM of preferred fatty acid substrate, and fatty acid profiles were obtained by GC at the indicated time points. In Panels A-J, Desaturation and Elongation were represented as %Conversion vs Growth Time (hours), and Product and Substrate levels were represented as %Total Fatty acid vs Growth time (hours).A. c-d5Des(Tc_GA2) + DHGLA B. c-d6Des(Ot_febit) + ALA C. c-d4Des(Pl_GA)2 + DTA D. c-d4Des(Tc_GA) + DTA E. c-o3Des(Pir_GA) + ARA F. c-o3Des(Pi_GA2) + ARA G. c-d12Des(Ps_GA) + OA H. c-d5Elo(Ot_GA3) + EPA I. c-d6Elo(Tp_GA2) + GLA J. c-d6Elo(Pp_GA2) + SDA.

Figure 32: Conversion efficiencies of delta-12-desaturation in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. Shown are average conversion efficiencies of various plant populations, as well as the conversion efficiencies observed in a seedbacth of event LBFDAU having highest EPA+DHA levels, and those efficiencies observed in a single seed of that

seedbatch, where this single seed had highest EPA+DHA levels among all 95 measured single seeds. Data were taken from Example 10 to Example 18. T0 and T1 designates the plant generation producing the seeds (all grown in the greenhouse except for the two LBFDAU datapoints)

Figure 33: Conversion efficiencies of delta-6-desaturation in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 34: Conversion efficiencies of delta-6-elongation in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 35: Conversion efficiencies of delta-5-desaturation in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 36: Conversion efficiencies of omega-3 desaturation (excluding C18 fatty acids) in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 37: Conversion efficiencies of omega-3 desaturation (including C18 fatty acids) in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 38: Conversion efficiencies of delta-5-elongation in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 39: Conversion efficiencies of delta-4-desturation in seed of transgenic Brassica napus and in Brassica napus wildtype seeds. See caption in Figure 32 for further details.

Figure 40: The sum of all pathway fatty acids was negatively correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 41: The sum of all pathway fatty acids was negatively correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 42: The sum of all pathway fatty acids was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis

of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 43: The sum of all pathway fatty acids was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 44: The conversion efficiency of the delta-12-desaturase was negatively correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seed batch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 45: The conversion efficiency of the delta-12-desaturase was negatively correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seed batch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 46: The conversion efficiency of the delta-12-desaturase was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 47: The conversion efficiency of the delta-12-desaturase was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 48: The conversion efficiency of the delta-6-desaturase was negatively correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 49: The conversion efficiency of the delta-6-desaturase was negatively correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 50: The conversion efficiency of the delta-6-desaturase was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 51: The conversion efficiency of the delta-6-desaturase was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 52: The conversion efficiency of the delta-6 elongase was not negatively correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 53: The conversion efficiency of the delta-6 elongase was not negatively correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 54: The conversion efficiency of the delta-6 elongase was not negatively correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 55: The conversion efficiency of the delta-6 elongase was not negatively correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 56: The conversion efficiency of the delta-5-desaturase was not correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 57: The conversion efficiency of the delta-5-desaturase was not correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 58: The conversion efficiency of the delta-5-desaturase was not correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 59: The conversion efficiency of the delta-5-desaturase was not correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 60: The conversion efficiency of the omega-3-desaturase was not correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 61: The conversion efficiency of the omega-3-desaturase was not correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 62: The conversion efficiency of the omega-3-desaturase was not correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 63: The conversion efficiency of the omega-3-desaturase was not correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 64: The conversion efficiency of the delta-5-elongase was not correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 65: The conversion efficiency of the delta-5-elongase was not correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 66: The conversion efficiency of the delta-5-elongase was not correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 67: The conversion efficiency of the delta-5-elongase was not correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing one plot.

Figure 68: The conversion efficiency of the delta-4-desaturase was negatively correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 69: The conversion efficiency of the delta-4-desaturase was negatively correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 70: The conversion efficiency of the delta-4-desaturase was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 71: The conversion efficiency of the delta-4-desaturase was negatively correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 72: The sum of all pathway fatty acids was not correlated with seed oil content in wildtype canola, but differs between greenhouse and field. Shown are data of three seasons. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 73: The total fatty acid percentage of 20:5n-3 (EPA) correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 74: The total fatty acid percentage of 20:5n-3 (EPA) correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 75: The total fatty acid percentage of 20:5n-3 (EPA) correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 76: The total fatty acid percentage of 20:5n-3 (EPA) correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 77: The total fatty acid percentage of 22:6n-3 (DHA) correlated with seed oil content. Shown are data of 3 generations of event LANPMZ. For the greenhouse data, one marker corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 78: The total fatty acid percentage of 22:6n-3 (DHA) correlated with seed oil content. Shown are data of 4 generations of event LAODDN. For the greenhouse data, one marker

corresponds to one seedbatch of one plant, for the field data, one marker corresponds to an analysis on a random selection of seeds representing one plot.

Figure 79: The total fatty acid percentage of 22:6n-3 (DHA) correlated with seed oil content. Shown are data of 2 generations of event LBFGKN. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 50 T2 seedbatches, or 182 T3 seedbatches, for the field data, one marker corresponds to an analysis of one T2 seedbtach of one T1 plant, or the analysis of a random selection of T3 seeds representing plots (36 plots) or single plants (60 plants).

Figure 80: The total fatty acid percentage of 22:6n-3 (DHA) correlated with seed oil content. Shown are data of 2 generations of event LBFLFK. For the greenhouse data, one marker corresponds to the analysis of a random selection of seeds representing a bulk of 10 T2 seedbatches, or 195 T3 seedbatches, for the field data, one marker corresponds to an analysis of 1 T2 seedbtach of one T1 plant, or a the analysis of a random selection of T3 seeds representing one plot.

Figure 81: The levels of EPA+DHA (20:5n-3 and 22:6n-3) correlated with seed oil content. Shown are data of homozygous plants (single plant: capital G or F, plots: lower case f, grown in greenhouses: G, grown in field trials: f and F). The data are described in more detail in Example 12 (event LANBCH), and Example 14 (all other events).

Figure 82: The levels of ARA (20:4n-6) correlated with seed oil content. Shown are data of homozygous plants (single plant: capital G or F, plots: lower case f, grown in greenhouses: G, grown in field trials: f and F). The data are described in more detail in Example 12 (event LANBCH), and Example 14 (all other events).

Figure 83: The levels of EPA (20:5n-3) correlated with seed oil content. Shown are data of homozygous plants (single plant: capital G or F, plots: lower case f, grown in greenhouses: G, grown in field trials: f and F). The data are described in more detail in Example 12 (event LANBCH), and Example 14 (all other events).

Figure 84: The levels of DHA (22:6n-3) correlated with seed oil content. Shown are data of homozygous plants (single plant: capital G or F, plots: lower case f, grown in greenhouses: G, grown in field trials: f and F). The data are described in more detail in Example 12 (event LANBCH), and example 14 (all other events).

Figure 85. Examples of Desaturase Enzyme Activity in Transgenic Brassica napus. [14C]Fatty acid methyl esters (ME's) were isolated from the enzymatic reactions, resolved by TLC as described for each specific enzyme and detected by electronic autoradiography using an Instant Imager. Duplicate reactions are shown for each enzyme activity in Panels A-C. In Panel A delta-6 desaturase (Ostreococcus tauri) activity was demonstrated by the presence of [14C]18:3n-6 ME using membranes isolated from transgenic Brassica napus. This desaturase activity was not

present in membranes derived from a wild-type (Kumily) B. napus. In Panel B delta-5 desaturase (Thraustochytrium ssp.) activity was demonstrated by the presence of [14C]20:4n-6 ME using membranes isolated from transgenic Brassica napus. This desaturase activity was not present in membranes derived from a wild-type (Kumily) B. napus. In Panel C omega-3 desaturase activity was demonstrated by the presence of [14C]20:5n-3 ME using membranes isolated from transgenic Brassica napus. This desaturase activity was not present in membranes derived from a wild-type (Kumily) B. napus.

Figure 86. Delta-12 desaturase (Phytophthora sojae), c-d12Des(Ps_GA), substrate preference. During the course of the enzymatic reaction the following lipid pools were isolated: phosphatidylcholine (PC, ■), free fatty acid (FFA, ·), and H2O (CoA, ○). In Panel A c-d12Des(Ps_GA) enzyme activity is shown using assay conditions to present the fatty acid substrate (18:1(n-9)) in the acyl-phosphatidylcholine form. Desaturated enzymatic product (18:2(n-6)) is found predominantly in the phosphatidylcholine (PC) pool, relative to the free fatty acid (FFA) or H2O (CoA) pools, indicating c-d12Des(Ps_GA) utilizes 18:1(n-9) attached to phosphatidylcholine as a substrate. In Panel B c-d12Des(Ps_GA) enzyme activity is shown using assay conditions to present the fatty acid substrate (18:1(n-9)) in the acyl-CoA form. Relative to Panel A, desaturated enzymatic product (18:2(n-6)) is not produced in the phosphatidylcholine (PC), free fatty acid (FFA) or H2O (CoA) pools indicating c-d12Des(Ps_GA) does not utilize 18:1(n-9) bound as an acyl-CoA ester.

Figure 87. Delta-9 desaturase (Saccharomyces cerevisiae), d9Des(Sc) substrate preference. During the course of the enzymatic reaction the following lipid pools were isolated: phosphatidylcholine (PC, ■), free fatty acid (FFA, ·), and H2O (CoA, ○). In Panel A d9Des(Sc) enzyme activity is shown using assay conditions to present the fatty acid substrate (16:0) in the acyl-phosphatidylcholine form. Relative to Panel B, desaturated enzymatic product (16:1(n-7)) is not produced in the phosphatidylcholine (PC), free fatty acid (FFA), or H2O (CoA) pools indicating d9Des(Sc) does not utilize 18:0 attached to phosphatidylcholine as a substrate. In Panel B d9Des(Sc) enzyme activity is shown using assay conditions to present the fatty acid substrate (16:0) in the acyl-CoA form. Desaturated enzymatic product (16:1(n-7)) is isolated in both the free fatty acid (FFA) and H2O (CoA) pools, but not the phosphatidylcholine (PC) pool. Furthermore, production of the desaturated enzymatic product (16:1(n-7)) in the H2O (CoA) pool is linear for the first 60 minutes of the assay as shown by the hashed line (r2 = 0.99). The high levels of [14C]16:1(n-7) detected in the FFA pool likely result from hydrolysis of the desaturated enzymatic product, 16:1(n-7)-CoA, by endogenous thioesterases present in the membrane preparations.

Figure 88. Yield (kg seeds/ha) of canola plants grown in the field in 2014. Plants were either not treated (Yield) or were treated with 2x rate of imidazolinone herbicide (Yield w/herbicide).

Figure 89. EPA plus DHA content in seeds of plants grown in the field with (Imazamox) or without (control) herbicide treatment. *** denotes a significant difference between herbicide treatment and control as calculated by ANOVA, p<0.05.

Figure 90. Oil content in seeds of plants grown in the field with (Imazamox) or without (control) herbicide treatment. *** denotes a significant difference between herbicide treatment and control as calculated by ANOVA, $p<0.05$.

Figure 91. Protein content in seeds of plants grown in the field with (Imazamox) or without (control) herbicide treatment. *** denotes a significant difference between herbicide treatment and control as calculated by ANOVA, $p<0.05$.

DETAILED DESCRIPTION OF THE INVENTION

Various aspects of the invention are hereinafter described in more detail. It is to be understood that the detailed description is not intended to limit the scope of the claims.

The term "polyunsaturated fatty acids (PUFA)" as used herein refers to fatty acids comprising at least two, preferably, three, four, five or six, double bonds. Moreover, it is to be understood that such fatty acids comprise, preferably from 18 to 24 carbon atoms in the fatty acid chain. More preferably, the term relates to long chain PUFA (VLC-PUFA) having from 20 to 24 carbon atoms in the fatty acid chain. Particularly, polyunsaturated fatty acids in the sense of the present invention are DHGLA 20:3 (8,11,14), ARA 20:4 (5,8,11,14), ETA 20:4 (8,11,14,17), EPA 20:5 (5,8,11,14,17), DPA 22:5 (4,7,10,13,16), DPA n-3 (7,10,13,16,19), DHA 22:6 (4,7,10,13,16,19), more preferably, eicosapentaenoic acid (EPA) 20:5 (5,8,11,14,17), and docosahexaenoic acid (DHA) 22:6 (4,7,10,13,16,19). Thus, it will be understood that most preferably, the methods provided by the present invention pertaining to the manufacture of EPA and/or DHA. Moreover, also encompassed are the intermediates of VLC-PUFA which occur during synthesis. Such intermediates are, preferably, formed from substrates by the desaturase, keto-acyl-CoA-synthase, keto-acyl-CoA-reductase, dehydratase and enoyl-CoA-reductase activity of the polypeptide of the present invention. Preferably, substrates encompass LA 18:2 (9,12), GLA 18:3 (6,9,12), DHGLA 20:3 (8,11,14), ARA 20:4 (5,8,11,14), eicosadienoic acid 20:2 (11,14), eicosatetraenoic acid 20:4 (8,11,14,17), eicosapentaenoic acid 20:5 (5,8,11,14,17). Systematic names of fatty acids including polyunsaturated fatty acids, their corresponding trivial names and shorthand notations used according to the present invention are given in table Table 18 (and in table 181). The transgenic plants of this invention produce a number of VLC-PUFA and intermediates that are non-naturally occurring in wild type Brassica plants. While these VLC-PUFA and intermediates may occur in various organisms, they do not occur in wild type Brassica plants. These fatty acids include 18:2n-9, GLA, SDA, 20:2n-9, 20:3n-9, 20:3 n-6, 20:4n-6, 22:2n-6, 22:5n-6, 22:4n-3, 22:5n-3, and 22:6n-3.

The term "cultivating" as used herein refers to maintaining and growing the transgenic plant under culture conditions which allow the cells to produce the said polyunsaturated fatty acids, i.e. the PUFAs and/or VLC-PUFAs referred to above. This implies that the polynucleotide of the present invention is expressed in the transgenic plant so that the desaturase, elongase as also the keto-acyl-CoA-synthase, keto-acyl-CoA-reductase, dehydratase and enoyl-CoA-reductase activity is present. Suitable culture conditions for cultivating the host cell are described in more detail below.

The term "obtaining" as used herein encompasses the provision of the cell culture including the host cells and the culture medium or the plant or plant part, particularly the seed, of the current invention, as well as the provision of purified or partially purified preparations thereof comprising the polyunsaturated fatty acids, preferably, ARA, EPA, DHA, in free or in CoA bound form, as membrane phospholipids or as triacylglyceride esters. More preferably, the PUFA and VLC-PUFA are to be obtained as triglyceride esters, e.g., in form of an oil. More details on purification techniques can be found elsewhere herein below.

The term "polynucleotide" according to the present invention refers to a desoxyribonucleic acid or ribonucleic acid. Unless stated otherwise, “polynucleotide” herein refers to a single strand of a DNA polynucleotide or to a double stranded DNA polynucleotide. The length of a polynucleotide is designated according to the invention by the specification of a number of basebairs (“bp”) or nucleotides (“nt”). According to the invention, both specifications are used interchangeably, regardless whether or not the respective nucleic acid is a single or double stranded nucleic acid. Also, as polynucleotides are defined by their respective nucleotide sequence, the terms nucleotide/polynucleotide and nucleotide sequence/polynucleotide sequence are used interchangeably, thus that a reference to a nucleic acid sequence also is meant to define a nucleic acid comprising or consisting of a nucleic acid stretch the sequence of which is identical to the nucleic acid sequence.

In particular, the term "polynucleotide" as used in accordance with the present invention as far as it relates to a desaturase or elongase gene relates to a polynucleotide comprising a nucleic acid sequence which encodes a polypeptide having desaturase or elongase activity. Preferably, the polypeptide encoded by the polynucleotide of the present invention having desaturase, or elongase activity upon expression in a plant shall be capable of increasing the amount of PUFA and, in particular, VLC-PUFA in, e.g., seed oils or an entire plant or parts thereof. Whether an increase is statistically significant can be determined by statistical tests well known in the art including, e.g., Student's t-test with a confidentiality level of at least 90%, preferably of at least 95% and even more preferably of at least 98%. More preferably, the increase is an increase of the amount of triglycerides containing VLC-PUFA of at least 5%, at least 10%, at least 15%, at least 20% or at least 30% compared to wildtype control (preferably by weight), in particular compared to seeds, seed oil, extracted seed oil, crude oil, or refined oil from a wild-type control. Preferably, the VLC-PUFA referred to before is a polyunsaturated fatty acid having a C20, C22 or C24 fatty acid body, more preferably EPA or DHA. Lipid analysis of oil samples are shown in the accompanying Examples.
Preferred polynucleotides encoding polypeptides having desaturase or elongase activity as shown in Table 130 in the Examples section (the SEQ ID Nos of the nucleic acid sequences and the polypeptide sequences are given in the last two columns).

In the plants of the present invention, in particular in the oil obtained or obtainable from the plant of the present invention, the content of certain fatty as shall be decreased or, in particular, increased as compared to the oil obtained or obtainable from a control plant. In particular decreased or increased as compared to seeds, seed oil, crude oil, or refined oil from a control plant. The choice of suitable control plants is a routine part of an experimental setup and may include corresponding wild type plants or corresponding plants without the polynucleotides as encoding desaturases and elongase as referred to herein. The control plant is typically of the same plant species or even of the same variety as the plant to be assessed. The control plant may also be a nullizygote of the plant to be assessed. Nullizygotes (or null control plants) are individuals missing the transgene by segregation. Further, control plants are grown under the same or essentially the same growing conditions to the growing conditions of the plants of the invention, i.e. in the vicinity of, and simultaneously with, the plants of the invention. A “control plant” as used herein preferably refers not only to whole plants, but also to plant parts, including seeds and seed parts. The control could also be the oil from a control plant.

Preferably, the control plant is an isogenic control plant. Thus, e.g. the control oil or seed shall be from an isogenic control plant.

The fatty acid esters with polyunsaturated C20- and/or C22-fatty acid molecules can be isolated in the form of an oil or lipid, for example, in the form of compounds such as sphingolipids, phosphoglycerides, lipids, glycolipids such as glycosphingolipids, phos-pholipids such as phosphatidylethanolamine, phosphatidylcholine, phosphatidylserine, phosphatidylglycerol, phosphatidylinositol or diphosphatidylglycerol, monoacylglycerides, diacylglycerides, triacylglycerides or other fatty acid esters such as the acetylcoenzyme A esters which comprise the polyunsaturated fatty acids with at least two, three, four, five or six, preferably five or six, double bonds, from the organisms which were used for the preparation of the fatty acid esters. Preferably, they are isolated in the form of their diacylglycerides, triacylglycerides and/or in the form of phosphatidylcholine, especially preferably in the form of the triacylglycerides. In addition to these esters, the polyunsaturated fatty acids are also present in the non-human transgenic organisms or host cells, preferably in the plants, as free fatty acids or bound in other compounds. As a rule, the various abovementioned compounds (fatty acid esters and free fatty acids) are present in the organisms with an approximate distribution of 80 to 90% by weight of triglycerides, 2 to 5% by weight of diglycerides, 5 to 10% by weight of monoglycerides, 1 to 5% by weight of free fatty acids, 2 to 8% by weight of phospholipids, the total of the various compounds amounting to 100% by weight. In the process of the invention, the VLC-PUFAs which have been produced are produced in a content as for DHA of at least 5,5% by weight, at least 6% by weight, at least 7% by weight, advantageously at least 8% by weight, preferably at least 9% by weight, especially preferably at least 10,5% by weight, very especially preferably at least 20% by weight, as for EPA of at least 9,5% by weight, at least 10% by weight, at least 11% by weight, advantageously at least 12% by weight, preferably at least 13% by weight, especially preferably at least 14,5% by weight, very especially preferably at least 30% by weight based on the total fatty acids in the non-human transgenic organisms or the host cell referred to above. The fatty acids are, preferably, produced in bound form. It is possible, with the aid of the polynucleotides and polypeptides of the present invention, for these unsaturated fatty acids to be positioned at the sn1, sn2 and/or sn3 position of the triglycerides which are, preferably, to be produced.

In a method or manufacturing process of the present invention the polynucleotides and polypeptides of the present invention may be used with at least one further polynucleotide encoding an enzyme of the fatty acid or lipid biosynthesis. Preferred enzymes are in this context the desaturases and elongases as mentioned above, but also a polynucleotide encoding an enzyme having delta-8-desaturase and/or delta-9-elongase activity. All these enzymes reflect the individual steps according to which the end products of the method of the present invention, for example EPA or DHA are produced from the starting compounds oleic acid (C18:1), linoleic acid (C18:2) or linolenic acid (C18:3). As a rule, these compounds are not generated as essentially pure products. Rather, small traces of the precursors may be also present in the end product. If, for example, both linoleic acid and linolenic acid are present in the starting host cell, organism, or the starting plant, the end products, such as EPA or DHA, are present as mixtures. The precursors should advantageously not amount to more than 20% by weight, preferably not to more than 15% by weight, more preferably, not to more than 10% by weight, most preferably not to more than 5% by weight, based on the amount of the end product in question. Alternatively if, for example, appropriately all three oleic acid, linoleic acid and linolenic acid are present in the starting host cell, organism, or the starting plant, the end products, such as EPA or DHA, are present as mixtures. The precursors should advantageously not amount to more than 60% by weight, preferably not to more than 40% by weight, more preferably, not to more than 20% by weight, most preferably not to more than 10% by weight, based on the amount of the end product in question. Advantageously, only EPA or more preferably only DHA, bound or as free acids, is/are produced as end product(s) in the process of the invention in a host cell. If the compounds EPA and DHA are produced simultaneously, they are, preferably, produced in a ratio of at least 1:2 (DHA:EPA), more preferably, the ratios are at least 1:5 and, most preferably, 1:8. Fatty acid esters or fatty acid mixtures produced by the invention, preferably, comprise 6 to 15% of palmitic acid, 1 to 6% of stearic acid, 7-85% of oleic acid, 0.5 to 8% of vaccenic acid, 0.1 to 1% of arachidic acid, 7 to 25% of saturated fatty acids, 8 to 85% of monounsaturated fatty acids and 60 to 85% of polyunsaturated fatty acids, in each case based on 100% and on the total fatty acid content of the organisms. DHA as a preferred long chain polyunsaturated fatty acid is present in the fatty acid esters or fatty acid mixtures in a concentration of, preferably, at least 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8; 0.9 or 1%, based on the total fatty acid content.

Chemically pure VLC-PUFAs or fatty acid compositions can also be synthesized by the methods described herein. To this end, the fatty acids or the fatty acid compositions are isolated from a corresponding sample via extraction, distillation, crystallization, chromatography or a combination of these methods. These chemically pure fatty acids or fatty acid compositions are advantageous for applications in the food industry sector, the cosmetic sector and especially the pharmacological industry sector.

The term "desaturase" encompasses all enzymatic activities and enzymes catalyzing the desaturation of fatty acids with different lengths and numbers of unsaturated carbon atom double bonds. Specifically this includes delta 4 (d4)-desaturase, catalyzing the dehydrogenation of the 4th and 5th carbon atom; Delta 5 (d5)-desaturase catalyzing the dehydrogenation of the 5th and 6th carbon atom; Delta 6 (d6)-desaturase catalyzing the dehydrogenation of the 6th and 7th carbon atom; Delta 8 (d8)-desaturase catalyzing the dehydrogenation of the 8th and 9th carbon atom; Deta 9 (d9)-desaturase catalyzing the dehydrogenation of the 9th and 10th carbon atom; Delta 12 (d12)-desaturase catalyzing the dehydrogenation of the 12th and 13th carbon atom; Delta 15 (d15)-desaturase catalyzing the dehydrogenation of the 15th and 16th carbon atom. An omega 3 (o3)-desaturase preferably catalyzes the dehydrogenation of the n-3 and n-2 carbon atom.

The terms "elongase" encompasses all enzymatic activities and enzymes catalyzing the elongation of fatty acids with different lengths and numbers of unsaturated carbon atom double bonds. Especially, the term "elongase" as used herein refers to the activity of an elongase, introducing two carbon molecules into the carbon chain of a fatty acid, preferably in the positions 1, 5, 6, 9, 12 and/or 15 of fatty acids, in particular in the positions 5, 6, 9, 12 and/or 15 of fatty acids.

Moreover, the term "elongase" as used herein preferably refers to the activity of an elongase, introducing two carbon molecules to the carboxyl ends (*i.e.* position 1) of both saturated and unsaturated fatty acids.

In the studies underlying this invention, enzymes with superior desaturase and elongase catalytic activities for the production of VLC-PUFA has been provided.

Tables 11 and 130 in the Examples section list preferred polynucleotides encoding for preferred desaturases or elongases to be used in the present invention. Thus, polynucleotides for desaturases or elongases that can be used in the context of the present invention are shown in Table 11 and 130, respectively. The SEQ ID NOs of these desaturases and elongases are shown in the last two columns of Table 130 (nucleic acid sequence and amino acid sequence). As set forth elsewhere herein, also variants of the said polynucleotides can be used.
Polynucleotides encoding polypeptides which exhibit delta-6-elongase activity have been described in WO2001/059128, WO2004/087902 and WO2005/012316, said documents, describing this enzyme from Physcomitrella patens, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit delta-5-desaturase activity have been described in WO2002026946 and WO2003/093482, said documents, describing this enzyme from Thraustochytrium sp., are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit delta-6-desaturase activity have been described in WO2005/012316, WO2005/083093, WO2006/008099 and WO2006/069710, said documents, describing this enzyme from Ostreococcus tauri, are incorporated herein in their entirety.

In a preferred embodiment of the present invention, the delta-6-desaturase is a CoA (Coenzyme A)-dependent delta-6-desaturase. Such enzymes are well known in the art. For example, the delta-6-desaturase from Ostreococcus tauri used in the the example section is a Coenzyme A-dependent delta-6-desaturase. The use of CoA (Coenzyme A)-dependent delta-6-desaturase in combination with a delta-12-desaturase may allow for reducing the content of 18:1n-9 in seeds, in particular in seed oil, as compared to a control. The use of CoA-dependent delta-6-desaturase in combination with a delta-6-elongase may allow for reducing the content of 18:3n-6 in seeds, in particular in seed oil, as compared to using a phospholipid-dependent delta-6-desaturase in combination with a delta-6-elongase.

Polynucleotides encoding polypeptides which exhibit delta-6-elongase activity have been described in WO2005/012316, WO2005/007845 and WO2006/069710, said documents, describing this enzyme from Thalassiosira pseudonana, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit delta-12-desaturase activity have been described for example in WO2006100241, said documents, describing this enzyme from Phytophthora sojae, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit delta-4-desaturase activity have been described for example in WO2004/090123, said documents, describing this enzyme from Euglena gracilis, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit delta-5-elongase activity have been described for example in WO2005/012316 and WO2007/096387, said documents, describing this enzyme from Ostreococcus tauri, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit omega 3-desaturase activity have been described for example in WO2008/022963, said documents, describing this enzyme from Pythium irregulare, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit omega 3-desaturase activity have been described for example in WO2005012316 and WO2005083053, said documents, describing this enzyme from Phytophthora infestans, are incorporated herein in their entirety.

Polynucleotides encoding polypeptides which exhibit delta-4-desaturase activity have been described for example in WO2002026946, said documents, describing this enzyme from Thraustochytrium sp., are incorporated herein in their entirety.

Polynucleotides coding for a delta-4 desaturase from Pavlova lutheri are described in WO2003078639 and WO2005007845. These documents are incorporated herein in their entirety, particularly in sofar as the documents relate to the delta-4 desaturase "PlDES 1"and figures 3a-3d of WO2003078639 and figures 3a, 3b of WO2005007845, respectively.

The polynucleotides encoding the aforementioned polypeptides are herein also referred to as “target genes” or “nucleic acid of interest”.The polynucleotides are well known in the art. The sequences of said polynucleotides can be found in the sequence of the T-DNAs disclosed in the Examples section (see e.g. the sequence of VC-LTM593-1qcz which has a sequence as shown in SEQ ID NO: 3). The SEQ ID Nos for the preferred polynucleotide and and polypeptide sequences are also given in Table 130 in the Examples section.

Sequences of preferred polynucleotides for the desaturases and elongases referred to herein in connection with the present invention are indicated below. As set forth elsewhere herein, also variants of the polynucleotides can be used. The polynucleotides encoding for desaturases and elogases to be used in accordance with the present invention can be derived from certain organisms. Preferably, a polynucleotide derived from an organism (e.g from Physcomitrella patens) is codon-optimized. In particular, the polynucleotide shall be codon-optimized for expression in a plant.

The term “codon-optimized” is well understood by the skilled person. Preferably, a codon optimized polynucleotide is a polynucleotide which is modified by comparison with the nucleic acid sequence in the organism from which the sequence originates in that it is adapted to the codon usage in one or more plant species. Typically, the polynucleotide, in particular the coding region, is adapted for expression in a given organism (in particular in a plant) by replacing at least one, or more than one of codons with one or more codons that are more frequently used in the genes of that organism (in particular of the plant). In accordance with the present invention, a codon optimized variant of a particular polynucleotide “from an organism” (or “derived from an organism”) preferably shall be considered to be a polynucleotide derived from said organism.

Preferably, a codon-optimized polynucleotide shall encode for the same polypeptide having the same sequence as the polypeptide encoded by the non codon-optimized polynucleotide (i.e. the wild-type sequence). In the studies underlying the present invention, codon optimized polynucleotides were used (for the desaturases). The codon optimized polynucleotides are comprised by the T-DNA of the vector having a sequence as shown in SEQ ID NO: 3 (see table 130).

Preferably, a delta-6-elongase to be used in accordance with the present invention is derived from Physcomitrella patens. A preferred sequence of said delta-6-elongase is shown in SEQ ID NO:258. Preferably, said delta-6-elongase is encoded by a polynucleotide derived from Physcomitrella patens, in particular, said delta-6-elongase is encoded by a codon-optimized variant thereof (i.e. of said polynucleotide). Preferably, the polynucleotide encoding the delta-6-elongase derived from Physcomitrella patens is a polynucleotide having a sequence as shown in nucleotides 1267 to 2139 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 257. (Thus, the polynucleotide encoding the delta-6-elongase derived from Physcomitrella patens preferably has a sequence as shown in SEQ ID NO: 257).

Preferably, a delta-5-desaturase to be used in accordance with the present invention is derived from Thraustochytrium sp.. Thraustochytrium sp. in the context of the present invention preferably means Thraustochytrium sp. ATCC21685. A preferred sequence of said delta-5-desaturase is shown in SEQ ID NO:260. Preferably, said delta-5-desaturase is encoded by a polynucleotide derived from Thraustochytrium sp.; in particular, said delta-5-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-5-desaturase derived from Thraustochytrium sp. is a polynucleotide having a sequence as shown in nucleotides 3892 to 5211 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 259. In accordance with the present invention, it is envisaged to express two or more polynucleotides (i.e. two or more copies of a polynucleotide) encoding a delta-5-desaturase derived from Thraustochytrium sp. (preferably two polynucleotides). Thus, the T-DNA, construct, plant, seed etc. of the present invention shall comprise two (or more) copies of a polynucleotide encoding a delta-5-desaturase derived from Thraustochytrium sp..

Preferably, a delta-6-desaturase to be used in accordance with the present invention is derived from Ostreococcus tauri. A preferred sequence of said delta-6-desaturase is shown in SEQ ID NO:262. Preferably, said delta-6-desaturase is encoded by a polynucleotide derived from Ostreococcus tauri; in particular, said delta-6-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-6-desaturase derived from Ostreococcus tauri is a polynucleotide having a sequence as shown in nucleotides 7802 to 9172 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 261.

Preferably, a delta-6-elongase to be used in accordance with the present invention is derived from Thalassiosira pseudonana. A preferred sequence of said delta-6-elongase is shown in SEQ ID NO:264. Preferably, said delta-6-elongase is encoded by a polynucleotide derived from Thalassiosira pseudonana; in particular, said delta-6-elongase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-6-elongase derived from Thalassiosira pseudonana is a polynucleotide having a sequence as shown in nucleotides 12099 to 12917 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 263.

Preferably, a delta-12-elongase to be used in accordance with the present invention is derived from Phytophthora sojae. A preferred sequence of said delta-12-elongase is shown in SEQ ID NO:266. Preferably, said delta-12-elongase is encoded by a polynucleotide derived from Phytophthora sojae; in particular, said delta-12-elongase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-12-elongase derived from Phytophthora sojae is a polynucleotide having a sequence as shown in nucleotides 14589 to 15785 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 265.

Preferably, a delta-5-elongase to be used in accordance with the present invention is derived from Ostreococcus tauri. A preferred sequence of said delta-5-elongase is shown in SEQ ID NO:276. Preferably, said delta-5-elongase is encoded by a polynucleotide derived from Ostreococcus tauri; in particular, said delta-5-elongase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-5-elongase derived from Ostreococcus tauri is a polynucleotide having a sequence as shown in nucleotides 38388 to 39290 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 275.

Preferably, an omega 3-desaturase to be used in accordance with the present invention is derived from Pythium irregulare. A preferred sequence of said omega 3-desaturase is shown in SEQ ID NO:268. Preferably, said omega 3-desaturase is encoded by a polynucleotide derived from Pythium irregulare; in particular, said omega 3-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the omega 3-desaturase derived from Pythium irregulare is a polynucleotide having a sequence as shown in nucleotides 17690 to 18781 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 267. In accordance with the present invention, it is envisaged to express two or more polynucleotides (i.e. two or more copies of a polynucleotide) encoding a omega 3-desaturase derived from Pythium irregulare (preferably two polynucleotides). Thus, the T-DNA, construct, plant, seed etc. of the present invention shall comprise two (or more) copies of a polynucleotide encoding a omega 3-desaturase derived from Pythium irregulare

Preferably, an omega 3-desaturase to be used in accordance with the present invention is derived from Phytophthora infestans. A preferred sequence of said omega 3-desaturase is shown in SEQ ID NO:270. Preferably, said omega 3-desaturase is encoded by a polynucleotide derived from Phytophthora infestans; in particular, said omega 3-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the omega 3-desaturase derived from Phytophthora infestans is a polynucleotide having a sequence as shown in nucleotides 20441 to 21526 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 269.

In accordance with the present invention, it is in particular envisaged to express two or more polynucleotides encoding for omega 3-desaturases in the plant. Preferably, at least one polynucleotide encoding an omega 3-desaturase from Phytophthora infestans and at least one polynucleotide (in particular two polynucleotides, i.e. two copies of a polynucleotide) encoding an omega 3-desaturase from Pythium irregulare are expressed.

Preferably, a delta-4-desaturase to be used in accordance with the present invention is derived from Thraustochytrium sp.. A preferred sequence of said delta-4-desaturase is shown in SEQ ID NO:272. Preferably, said delta-4-desaturase is encoded by a polynucleotide derived from Thraustochytrium sp.; in particular, said delta-4-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-4-desaturase derived from Thraustochytrium sp. is a polynucleotide having a sequence as shown in nucleotides 26384 to 27943 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 271.

Preferably, a delta-4-desaturase to be used in accordance with the present invention is derived from Pavlova lutheri. A preferred sequence of said delta-4-desaturase is shown in SEQ ID

NO:274. Preferably, said delta-4-desaturase is encoded by a polynucleotide derived from Pavlova lutheri; in particular, said delta-4-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-4-desaturase derived from Pavlova lutheri is a polynucleotide having a sequence as shown in nucleotides 34360 to 35697 of SEQ ID NO: 3. The sequence of this polynucleotide is also shown in SEQ ID No: 273.

In accordance with the present invention, it is further envisaged to express two non-identical polynucleotides encoding, preferably non-identical delta-4-desaturases in the plant. Preferably, at least one polynucleotide encoding a delta-4-desaturase from Thraustochytrium sp. and at least one polynucleotide encoding a delta-4-desaturase from Pavlova lutheri are expressed.

Preferably, a delta-15-desaturase to be used in accordance with the present invention is derived from Cochliobolus heterostrophus. Preferably, said delta-15-desaturase is encoded by a polynucleotide derived from Cochliobolus heterostrophus; in particular, said delta-15-desaturase is encoded by a codon-optimized variant of said polynucleotide. Preferably, the polynucleotide encoding the delta-15-desaturase derived from Cochliobolus heterostrophus is a polynucleotide having a sequence as shown in nucleotides 2151 to 3654 of SEQ ID NO: 9.

As set forth above, the polynucleotide encoding a delta-6-elongase can be derived from Physcomitrella patens. Moreover, the polynucleotide encoding a delta-6-elongase can be derived from Thalassiosira pseudonana. In particular, it is envisaged in the context of the present invention to express at least one polynucleotide encoding a delta-6-elongase from Physcomitrella patens and at least one polynucleotide encoding a delta-6-elongase from Thalassiosira pseudonana in the plant. Thus, the T-DNA, plant, seed etc. shall comprise the said polynucleotides.

A polynucleotide encoding a polypeptide having a desaturase or elongase activity as specified above is obtainable or obtained in accordance with the present invention for example from an organism of genus Ostreococcus, Thraustochytrium, Euglena, Thalassiosira, Phytophthora, Pythium, Cochliobolus, Physcomitrella. However, orthologs, paralogs or other homologs may be identified from other species. Preferably, they are obtained from plants such as algae, for example Isochrysis, Mantoniella, Crypthecodinium, algae/diatoms such as Phaeodactylum, mosses such as Ceratodon, or higher plants such as the Primulaceae such as Aleuritia, Calendula stellata, Osteospermum spinescens or Osteospermum hyoseroides, microorganisms such as fungi, such as Aspergillus, Entomophthora, Mucor or Mortierella, bacteria such as Shewanella, yeasts or animals. Preferred animals are nematodes such as Caenorhabditis, insects or vertebrates. Among the vertebrates, the nucleic acid molecules may, preferably, be derived from Euteleostomi, Actinopterygii; Neopterygii; Teleostei; Euteleostei, Protacanthopterygii, Salmoniformes; Salmonidae or Oncorhynchus, more preferably, from the order of the Salmoniformes, most preferably, the family of the Salmonidae, such as the genus Salmo, for example from the genera and species Oncorhynchus mykiss, Trutta trutta or Salmo trutta fario. Moreover, the nucleic acid molecules may be obtained from the diatoms such as the genera Thalassiosira or Phaeodactylum.

Thus, the term "polynucleotide" as used in accordance with the present invention further encompasses variants or derivatives of the aforementioned specific polynucleotides representing orthologs, paralogs or other homologs of the polynucleotide of the present invention. Moreover, variants or derivatives of the polynucleotide of the present invention also include artificially generated muteins. Said muteins include, e.g., enzymes which are generated by mutagenesis techniques and which exhibit improved or altered substrate specificity, or codon optimized polynucleotides.

Nucleic acid variants or derivatives according to the invention are polynucleotides which differ from a given reference polynucleotide by at least one nucleotide substitution, addition and/or deletion. If the reference polynucleotide codes for a protein, the function of this protein is conserved in the variant or derivative polynucleotide, such that a variant nucleic acid sequence shall still encode a polypeptide having a desaturase or elongase activity as specified above. Variants or derivatives also encompass polynucleotides comprising a nucleic acid sequence which is capable of hybridizing to the aforementioned specific nucleic acid sequences, preferably, under stringent hybridization conditions. These stringent conditions are known to the skilled in the art and can be found in Current Protocols in Molecular Biology, John Wiley & Sons, N. Y. (1989), 6.3.1-6.3.6. A preferred example for stringent hybridization conditions are hybridization conditions in 6X sodium chloride/sodium citrate (= SSC) at approximately 45°C, followed by one or more wash steps in 0.2X SSC, 0.1% SDS at 50 to 65°C. The skilled worker knows that these hybridization conditions differ depending on the type of nucleic acid and, for example when organic solvents are present, with regard to the temperature and concentration of the buffer. For example, under “standard hybridization conditions” the temperature ranges depending on the type of nucleic acid between 42°C and 58°C in aqueous buffer with a concentration of 0.1 to 5X SSC (pH 7.2). If organic solvent is present in the abovementioned buffer, for example 50% formamide, the temperature under standard conditions is approximately 42°C. The hybridization conditions for DNA: DNA hybrids are, preferably, 0.1X SSC and 20°C to 45°C, preferably between 30°C and 45°C. The hybridization conditions for DNA:RNA hybrids are, preferably, 0.1X SSC and 30°C to 55°C, preferably between 45°C and 55°C. The abovementioned hybridization temperatures are determined for example for a nucleic acid with approximately 100 bp (= base pairs) in length and a G + C content of 50% in the absence of formamide. The skilled worker knows how to determine the hybridization conditions required by referring to textbooks such as the textbook mentioned above, or the following textbooks: Sambrook et al., "Molecular Cloning”, Cold Spring Harbor Laboratory, 1989; Hames and Higgins (Ed.) 1985, ”Nucleic Acids Hybridization: A Practical Approach”, IRL Press at Oxford University Press, Oxford; Brown (Ed.) 1991, "Essential Molecular Biology: A Practical Approach”, IRL Press at Oxford University Press, Oxford. In an embodiment, stringent hybridization conditions encompass hybridization at 65°C in 1x SSC, or at 42°C in 1x SSC and 50% formamide, followed by washing at 65°C in 0.2x SSC. In another embodiment, stringent hybridization conditions encompass hybridization at 65°C in 1x SSC, or at 42°C in 1x SSC and 50% formamide, followed by washing at 65°C in 0.1x SSC.

Alternatively, polynucleotide variants are obtainable by PCR-based techniques such as mixed oligonucleotide primer based amplification of DNA, i.e. using degenerate primers against conserved domains of the polypeptides of the present invention. Conserved domains of the polypeptide of the present invention may be identified by a sequence comparison of the nucleic acid sequences of the polynucleotides or the amino acid sequences of the polypeptides of the present invention. Oligonucleotides suitable as PCR primers as well as suitable PCR conditions are described in the accompanying Examples. As a template, DNA or cDNA from bacteria, fungi, plants or animals may be used. Further, variants include polynucleotides comprising nucleic acid sequences which are at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98% or at least 99% identical to the nucleic acid coding sequences shown in any one of the T-DNA sequences given in the corresponding tables of the examples. Of course, the variants must retain the function of the respective enzyme, e.g. a variant of a delta-4-desaturase shall have delta-4-desaturase activity.

The percent identity values are, preferably, calculated over the entire amino acid or nucleic acid sequence region. A series of programs based on a variety of algorithms is available to the skilled worker for comparing different sequences. In a preferred embodiment, the percent identity between two amino acid sequences is determined using the Needleman and Wunsch algorithm (Needleman 1970, J. Mol. Biol. (48):444-453) which has been incorporated into the needle program in the EMBOSS software package (EMBOSS: The European Molecular Biology Open Software Suite, Rice, P., Longden, I., and Bleasby, A., Trends in Genetics 16(6), 276-277, 2000), a BLOSUM62 scoring matrix, and a gap opening penalty of 10 and a gap entension pentalty of 0.5. Guides for local installation of the EMBOSS package as well as links to WEB-Services can be found at http://emboss.sourceforge.net. A preferred, non-limiting example of parameters to be used for aligning two amino acid sequences using the needle program are the default parameters, including the EBLOSUM62 scoring matrix, a gap opening penalty of 10 and a gap extension penalty of 0.5. In yet another preferred embodiment, the percent identity between two nucleotide sequences is determined using the needle program in the EMBOSS software package (EMBOSS: The European Molecular Biology Open Software Suite, Rice, P., Longden, I., and Bleasby, A., Trends in Genetics 16(6), 276-277, 2000), using the EDNAFULL scoring matrix and a gap opening penalty of 10 and a gap extension penalty of 0.5. A preferred, non-limiting example of parameters to be used in conjunction for aligning two nucleic acid sequences using the needle program are the default parameters, including the EDNAFULL scoring matrix, a gap opening penalty of 10 and a gap extension penalty of 0.5. The nucleic acid and protein sequences of the present invention can further be used as a “query sequence” to perform a search against public databases to, for example, identify other family members or related sequences. Such searches can be performed using the BLAST series of programs (version 2.2) of Altschul et al. (Altschul 1990, J. Mol. Biol. 215:403-10). BLAST using desaturase and elongase nucleic acid sequences of the invention as query sequence can be performed with the BLASTn, BLASTx or the tBLASTx program using default parameters to obtain either nucleotide sequences (BLASTn, tBLASTx) or amino acid sequences (BLASTx) homologous to desaturase and elongase sequences of the invention. BLAST using desaturase and elongase protein sequences of the invention as query sequence can be performed with the BLASTp or the tBLASTn program using default parameters to obtain either amino acid sequences (BLASTp) or nucleic acid sequences (tBLASTn) homologous to desaturase and elongase sequences of the invention. To obtain gapped alignments for comparison purposes, Gapped BLAST using default parameters can be utilized as described in Altschul et al. (Altschul 1997, Nucleic Acids Res. 25(17):3389-3402).

In an embodiment, a variant of a polynucleotide encoding a desaturase or elongase as referred to herein is, preferably, a polynucleotide comprising a nucleic acid sequence selected from the group consisting of:

a) a nucleic acid sequence being at least 70%, 80%, or 90% identical to the nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NOs: 257, 259, 261, 263, 265, 267, 269, 271, 273, or 275,
b) a nucleic acid sequence encoding a polypeptide which is at least 70%, 80, or 90% identical to a polypeptide having an amino acid sequence as shown in SEQ ID NOs: 258, 260, 262, 264, 266, 268, 270, 272, 274, or 276, and
c) a nucleic acid sequence which is capable of hybridizing under stringent conditions to i) a nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NOs: 257, 259, 261, 263, 265, 267, 269, 271, 273, or 275, or to ii) a nucleic acid sequence encoding a polypeptide having an amino acid sequence as shown in SEQ ID NOs: 258, 260, 262, 264, 266, 268, 270, 272, 274, or 276.

As set forth above, the polypeptide encoded by said nucleic acid must retain the function of the respective enzyme. For example, the polypeptide having a sequence as shown in SEQ ID NO: 270 has omega-3-desaturase activity. Accordingly, the variant of this polypeptide also shall have omega-3-desaturase activity. The function of desaturases and elongases of the present invention is analyzed in Example 22.

Thus, a polynucleotide encoding a desaturase or elongase as referred to herein is, preferably, a polynucleotide comprising a nucleic acid sequence selected from the group consisting of:

a) a nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NO: 257, 259, 261, 263, 265, 267, 269, 271, 273, or 275,
b) a nucleic acid sequence encoding a polypeptide having an amino acid sequence as shown in SEQ ID NO: 258, 260, 262, 264, 266, 268, 270, 272, 274, or 276
c) a nucleic acid sequence being at least 70%, 80%, or 90% identical to the nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NOs: 257, 259, 261, 263, 265, 267, 269, 271, 273, or 275,
d) a nucleic acid sequence encoding a polypeptide which is at least 70%, 80, or 90% identical to a polypeptide having an amino acid sequence as shown in SEQ ID NOs 258, 260, 262, 264, 266, 268, 270, 272, 274, or 276, and
e) a nucleic acid sequence which is capable of hybridizing under stringent conditions to i) a nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NOs: 257, 259, 261, 263, 265, 267, 269, 271, 273, or 275, or to ii) a nucleic acid sequence encoding a polypeptide having an amino acid sequence as shown in SEQ ID NOs: 258, 260, 262, 264, 266, 268, 270, 272, 274, or 276.

The event LBFLFK comprises two T-DNA insertions, the insertions being designated LBFLFK Locus 1 and LBFLFK Locus 2. Plants comprising this insertion were generated by transformation with the T-DNA vector having a sequence as shown in SEQ ID NO: 3. Sequencing of the insertions present in the plant revealed that each locus contained a point mutation in a coding sequence resulting in a single amino acid exchange. The mutations did not affect the function of the genes. Locus 1 has a point mutation in the coding sequence for the delta-12 desaturase from Phythophthora sojae (d12Des(Ps)). The resulting polynucleotide has a sequence as shown in SEQ ID NO: 324. Said polynucleotide encodes a polypeptide having a sequence as shown in SEQ ID NO: 325. Locus 2 has a point mutation in the coding sequence for the delta-4 desaturase from Pavlova lutheri (d4Des(Pl)). The resulting polynucleotide has a sequence as shown in SEQ ID NO: 326. Said polynucleotide encodes a polypeptide having a sequence as shown in SEQ ID NO: 327. The aforementioned polynucleotides are considered as variants of the polynucleotide encoding the delta-12 desaturase from Phythophthora sojae and the polynucleotide encoding the delta-4 desaturase from Pavlova lutheri. The polynucleotides are considered as variants and can be used in the context of the present invention.

A polynucleotide comprising a fragment of any nucleic acid, particularly of any of the aforementioned nucleic acid sequences, is also encompassed as a polynucleotide of the present invention. The fragments shall encode polypeptides which still have desaturase or elongase activity as specified above. Accordingly, the polypeptide may comprise or consist of the domains of the polypeptide of the present invention conferring the said biological activity. A fragment as meant herein, preferably, comprises at least 50, at least 100, at least 250 or at least 500 consecutive nucleotides of any one of the aforementioned nucleic acid sequences or encodes an amino acid sequence comprising at least 20, at least 30, at least 50, at least 80, at least 100 or at least 150 consecutive amino acids of any one of the aforementioned amino acid sequences.

The variant polynucleotides or fragments referred to above, preferably, encode polypeptides retaining desaturase or elongase activity to a significant extent, preferably, at least 10%, at least 20%, at least 30%, at least 40%, at least 50%, at least 60%, at least 70%, at least 80% or at least 90% of the desaturase or elongase activity exhibited by any of the polypeptide comprised in any of the T-DNAs given in the accompanying Examples (in particular of the desaturase or elongases listed in Table 11 and 130)

Further enzymes beneficial for the present invention as described in detail in the examples are aclytransferases and transacylases (cf. WO 2011161093 A1). One group of acyltransferases having three distinct enzymatic activities are enzymes of the "Kennedy pathway", which are located on the cytoplasmic side of the membrane system of the endoplasmic reticulum (ER). The ER-bound acyltransferases in the microsomal fraction use acyl-CoA as the activated form of fatty acids. Glycerol-3-phosphate acyltransferase (GPAT) catalyzes the incorporation of acyl groups at the sn-1 position of glycerol-3-phosphate. 1-Acylglycerol-3-phosphate acyltransferase, also known as lysophosphatidic acid acyltransferase (LPAAT), catalyze the incorporation of acyl groups at the sn-2 position of lysophosphatidic acid (LPA). After dephosphorylation of phosphatidic acid by phosphatidic acid phosphatase (PAP), diacylglycerol acyltransferase (DGAT) catalyzes the incorporation of acyl groups at the sn-3 position of diacylglycerols. Further enzymes directly involved in TAG biosynthesis - apart from the said Kennedy pathway enzymes - are the phospholipid diacylglycerol acyltransferase (PDAT), an enzyme that transfers acyl groups from the sn-2 position of membrane lipids to the sn-3 position of diacylglycerols, and diacylglyceroldiacylglycerol transacylase (DDAT), an enzyme that transfers acylgroups from the sn-2 position of one diacylglycerol-molecule to the sn-3 position of another diacylglycerol-molecule. Lysophospholipid acyltransferase (LPLAT) represents a class of acyltransferases that are capable of incorporating activated acyl groups from acyl-CoA to membrane lipids, and possibly also catalyze the reverse reaction. More specifically, LPLATs can have activity as lysophosphophatidylethanolamine acyltransferase (LPEAT) and lysophosphatidylcholine acyltransferase (LPCAT). Further enzymes, such as lecithin cholesterol acyltransferase (LCAT) can be involved in the transfer of acyl groups from membrane lipids into triacylglycerides, as well. The documents WO 98/54302 and WO 98/54303 disclose a human LPAAT and its potential use for the therapy of diseases, as a diagnostic, and a method for identifying modulators of the human LPAAT. Moreover, a variety of acyltransferases with a wide range of enzymatic functions have been described in the documents WO 98/55632, WO 98/55631 , WO 94/13814, WO 96/24674, WO 95/27791, WO 00/18889, WO 00/18889, WO 93/10241, Akermoun 2000, Biochemical Society Transactions 28: 713-715, Tumaney 1999, Biochimica et Biophysica Acta 1439: 47-56, Fraser 2000, Biochemical Society Transactions 28: 715- 7718, Stymne 1984, Biochem. J. 223: 305-314, Yamashita 2001, Journal of Biological Chemistry 276: 26745-26752, and WO 00/18889.

In order to express the polynucleotides encoding the desaturases or elongases as set forth in connection with the present invention, the polynucleotides shall be operably linked to expression control sequences. Preferably, the expression control sequences are heterologous with respect to the polynucleotides operably linked thereto. It is to be understood that each polynucleotide is operably linked to an expression control sequence.

The term “expression control sequence” as used herein refers to a nucleic acid sequence which is capable of governing, i.e. initiating and controlling, transcription of a nucleic acid sequence of interest, in the present case the nucleic sequences recited above. Such a sequence usually comprises or consists of a promoter or a combination of a promoter and enhancer sequences. Expression of a polynucleotide comprises transcription of the nucleic acid molecule, preferably, into a translatable mRNA. Additional regulatory elements may include transcriptional as well as translational enhancers. The following promoters and expression control sequences may be, preferably, used in an expression vector according to the present invention. The cos, tac, trp, tet, trp-tet, lpp, lac, lpp-lac, laclq, T7, T5, T3, gal, trc, ara, SP6, λ-PR or λ-PL promoters are, preferably, used in Gram-negative bacteria. For Gram-positive bacteria, promoters amy and SPO2 may be used. From yeast or fungal promoters ADC1, AOX1r, GAL1, MFα, AC, P-60, CYC1, GAPDH, TEF, rp28, ADH are, preferably, used. For animal cell or organism expression, the promoters CMV-, SV40-, RSV-promoter (Rous sarcoma virus), CMV-enhancer, SV40-enhancer are preferably used. From plants the promoters CaMV/35S (Franck 1980, Cell 21: 285-294], PRP1 (Ward 1993, Plant. Mol. Biol. 22), SSU, OCS, lib4, usp, STLS1, B33, nos or the ubiquitin or phaseolin promoter. Also preferred in this context are inducible promoters, such as the promoters described in EP 0388186 A1 (i.e. a benzylsulfonamide-inducible promoter), Gatz 1992, Plant J. 2:397-404 (i.e. a tetracyclin-inducible promoter), EP 0335528 A1 (i.e. a abscisic-acid-inducible promoter) or WO 93/21334 (i.e. a ethanol- or cyclohexenol-inducible promoter). Further suitable plant promoters are the promoter of cytosolic FBPase or the ST-LSI promoter from potato (Stockhaus 1989, EMBO J. 8, 2445), the phosphoribosyl-pyrophosphate amidotransferase promoter from Glycine max (Genbank accession No. U87999) or the node-specific promoter described in EP 0249676 A1. Particularly preferred are promoters which enable the expression in tissues which are involved in the biosynthesis of fatty acids. Also particularly preferred are seed-specific promoters such as the USP promoter in accordance with the practice, but also other promoters such as the LeB4, DC3, phaseolin or napin promoters. Further especially preferred promoters are seed-specific promoters which can be used for monocotyledonous or dicotyledonous plants and which are described in US 5,608,152 (napin promoter from oilseed rape), WO 98/45461 (oleosin promoter from Arobidopsis, US 5,504,200 (phaseolin promoter from Phaseolus vulgaris), WO 91/13980 (Bce4 promoter from Brassica), by Baeumlein et al., Plant J., 2, 2, 1992:233-239 (LeB4 promoter from a legume), these promoters being suitable for dicots. The following promoters are suitable for monocots: lpt-2 or lpt-1 promoter from barley (WO 95/15389 and WO 95/23230), hordein promoter from barley and other promoters which are suitable and which are described in WO 99/16890. In principle, it is possible to use all natural promoters together with their regulatory sequences, such as those mentioned above, for the novel process. Likewise, it is possible and advantageous to use synthetic promoters, either additionally or alone, especially when they mediate a seed-specific expression, such as, for example, as described in WO 99/16890. Preferably, the polynucleotides encoding the desaturases and elongases as referred to herein are expressed in the seeds of the plants. In a particular embodiment, seed-specific promoters are utilized to enhance the production of the desired PUFA or VLC-PUFA. In a particular preferred embodiment the polynucleotides encoding the desaturares or elongases are operably linked to expression control sequences used for the the expression of the respective desaturases and elongases in the Examples section (see e.g. the promoters used for expressing the elongases and desaturases in VC-LTM593-1qcz rc, Table 11). The sequence of this vector is shown in SEQ ID NO: 3.

The term “operatively linked” as used herein means that the expression control sequence and the nucleic acid of interest are linked so that the expression of the said nucleic acid of interest can be governed by the said expression control sequence, i.e. the expression control sequence shall be functionally linked to the said nucleic acid sequence to be expressed. Accordingly, the expression control sequence and, the nucleic acid sequence to be expressed may be physically linked to each other, e.g., by inserting the expression control sequence at the 5´end of the nucleic acid sequence to be expressed. Alternatively, the expression control sequence and the nucleic acid to be expressed may be merely in physical proximity so that the expression control sequence is capable of governing the expression of at least one nucleic acid sequence of interest. The expression control sequence and the nucleic acid to be expressed are, preferably, separated by not more than 500 bp, 300 bp, 100 bp, 80 bp, 60 bp, 40 bp, 20 bp, 10 bp or 5 bp.

Preferred polynucleotides of the present invention comprise, in addition to a promoter, a terminator sequence operatively linked to the nucleic acid sequence of interest.
The term “terminator” as used herein refers to a nucleic acid sequence which is capable of terminating transcription. These sequences will cause dissociation of the transcription machinery from the nucleic acid sequence to be transcribed. Preferably, the terminator shall be active in plants and, in particular, in plant seeds. Suitable terminators are known in the art and, preferably, include polyadenylation signals such as the SV40-poly-A site or the tk-poly-A site or one of the plant specific signals indicated in Loke et al. (Loke 2005, Plant Physiol 138, pp. 1457-1468), downstream of the nucleic acid sequence to be expressed.

The invention furthermore relates to recombinant nucleic acid molecules comprising at least one nucleic acid sequence which codes for a polypeptide having desaturase and/or elongase activity which is modified by comparison with the nucleic acid sequence in the organism from which the sequence originates in that it is adapted to the codon usage in one or more plant species.

For the purposes of the invention "recombinant" means with regard to, for example, a nucleic acid sequence, an expression cassette (=gene construct) or a vector comprising the nucleic acid sequences used in the process according to the invention or a host cell transformed with the nucleic acid sequences, expression cassette or vector used in the process according to the invention, all those constructions brought about by recombinant methods in which either the nucleic acid sequence, or a genetic control sequence which is operably linked with the nucleic acid sequence, for example a promoter, or are not located in their natural genetic environment or have been modified by recombinant methods.

Preferably, the plant cell (or plant) of the present invention is an oilseed crop plant cell (or oilseed crop plant). More preferably, said oilseed crop is selected from the group consisting of flax (Linum sp.), rapeseed (Brassica sp.), soybean (Glycine and Soja sp.), sunflower (Helianthus sp.), cotton (Gossypium sp.), corn (Zea mays), olive (Olea sp.), safflower (Carthamus sp.), cocoa (Theobroma cacoa), peanut (Arachis sp.), hemp, camelina, crambe, oil palm, coconuts, groundnuts, sesame seed, castor bean, lesquerella, tallow tree, sheanuts, tungnuts, kapok fruit, poppy seed, jojoba seeds and perilla. Preferred plants to be used for introducing the polynucleotide or T-DNA of the invention are plants which are capable of synthesizing fatty acids, such as all dicotyledonous or monocotyledonous plants, algae or mosses. It is to be understood that host cells derived from a plant may also be used for producing a plant according to the present invention. Preferred plants are selected from the group of the plant families Adelotheciaceae, Anacardiaceae, Arecaceae, Asteraceae, Apiaceae, Betulaceae, Boraginaceae, Brassicaceae, Bromeliaceae, Caricaceae, Cannabaceae, Convolvulaceae, Chenopodiaceae, Compositae, Crypthecodiniaceae, Cruciferae, Cucurbitaceae, Ditrichaceae, Elaeagnaceae, Ericaceae, Euphorbiaceae, Fabaceae, Geraniaceae, Gramineae, Juglandaceae, Lauraceae, Leguminosae, Linaceae, Malvaceae, Moringaceae, Marchantiaceae, Onagraceae, Olacaceae, Oleaceae, Papaveraceae, Piperaceae, Pedaliaceae, Poaceae, Solanaceae, Prasinophyceae or vegetable plants or ornamentals such as Tagetes. Examples which may be mentioned are the following plants selected from the group consisting of: Adelotheciaceae such as the genera Physcomitrella, such as the genus and species Physcomitrella patens, Anacardiaceae such as the genera Pistacia, Mangifera, Anacardium, for example the genus and species Pistacia vera [pistachio], Mangifer indica [mango] or Anacardium occidentale [cashew], Asteraceae, such as the genera Calendula, Carthamus, Centaurea, Cichorium, Cynara, Helianthus, Lactuca, Locusta, Tagetes, Valeriana, for example the genus and species Calendula officinalis [common marigold], Carthamus tinctorius [safflower], Centaurea cyanus [cornflower], Cichorium intybus [chicory], Cynara scolymus [artichoke], Helianthus annus [sunflower], Lactuca sativa, Lactuca crispa, Lactuca esculenta, Lactuca scariola L. ssp. sativa, Lactuca scariola L. var. integrata, Lactuca scariola L. var. integrifolia, Lactuca sativa subsp. romana, Locusta communis, Valeriana locusta [salad vegetables], Tagetes lucida, Tagetes erecta or Tagetes tenuifolia [african or french marigold], Apiaceae, such as the genus Daucus, for example the genus and species Daucus carota [carrot], Betulaceae, such as the genus Corylus, for example the genera and species Corylus avellana or Corylus colurna [hazelnut], Boraginaceae, such as the genus Borago, for example the genus and species Borago officinalis [borage], Brassicaceae, such as the genera Brassica, Melanosinapis, Sinapis, Arabadopsis, for example the genera and species Brassica napus, Brassica rapa ssp. [oilseed rape], Sinapis arvensis Brassica juncea, Brassica juncea var. juncea, Brassica juncea var. crispifolia, Brassica juncea var. foliosa, Brassica nigra, Brassica sinapioides, Melanosinapis communis [mustard], Brassica oleracea [fodder beet] or Arabidopsis thaliana, Bromeliaceae, such as the genera Anana, Bromelia (pineapple), for example the genera and species Anana comosus, Ananas ananas or Bromelia comosa [pineapple], Caricaceae, such as the genus Carica, such as the genus and species Carica papaya [pawpaw], Cannabaceae, such as the genus Cannabis, such as the genus and species Cannabis sativa [hemp], Convolvulaceae, such as the genera Ipomea, Convolvulus, for example the genera and species Ipomoea batatus, Ipomoea pandurata, Convolvulus batatas, Convolvulus tiliaceus, Ipomoea fastigiata, Ipomoea tiliacea, Ipomoea triloba or Convolvulus panduratus [sweet potato, batate], Chenopodiaceae, such as the genus Beta, such as the genera and species Beta vulgaris, Beta vulgaris var. altissima, Beta vulgaris var.Vulgaris, Beta maritima, Beta vulgaris var. perennis, Beta vulgaris var. conditiva or Beta vulgaris var. esculenta [sugarbeet], Crypthecodiniaceae, such as the genus Crypthecodinium, for example the genus and species Cryptecodinium cohnii, Cucurbitaceae, such as the genus Cucurbita, for example the genera and species Cucurbita maxima, Cucurbita mixta, Cucurbita pepo or Cucurbita moschata [pumpkin/squash], Cymbellaceae such as the genera Amphora, Cymbella, Okedenia, Phaeodactylum, Reimeria, for example the genus and species Phaeodactylum tricornutum, Ditrichaceae such as the genera Ditrichaceae, Astomiopsis, Ceratodon, Chrysoblastella, Ditrichum, Distichium, Eccremidium, Lophidion, Philibertiella, Pleuridium, Saelania, Trichodon, Skottsbergia, for example the genera and species Ceratodon antarcticus, Ceratodon columbiae, Ceratodon heterophyllus, Ceratodon purpureus, Ceratodon purpureus, Ceratodon purpureus ssp. convolutus, Ceratodon, purpureus spp. stenocarpus, Ceratodon purpureus var. rotundifolius, Ceratodon ratodon, Ceratodon stenocarpus, Chrysoblastella chilensis, Ditrichum ambiguum, Ditrichum brevisetum, Ditrichum crispatissimum, Ditrichum difficile, Ditrichum falcifolium, Ditrichum flexicaule, Ditrichum giganteum, Ditrichum heteromallum, Ditrichum lineare, Ditrichum lineare, Ditrichum montanum, Ditrichum montanum, Ditrichum pallidum, Ditrichum punctulatum, Ditrichum pusillum, Ditrichum pusillum var. tortile, Ditrichum rhynchostegium, Ditrichum schimperi, Ditrichum tortile, Distichium capillaceum, Distichium hagenii, Distichium inclinatum, Distichium macounii, Eccremidium floridanum, Eccremidium whiteleggei, Lophidion strictus, Pleuridium acuminatum, Pleuridium alternifolium, Pleuridium holdridgei, Pleuridium mexicanum, Pleuridium ravenelii, Pleuridium subulatum, Saelania glaucescens, Trichodon borealis, Trichodon cylindricus or Trichodon cylindricus var. oblongus, Elaeagnaceae such as the genus Elaeagnus, for example the genus and species Olea europaea [olive], Ericaceae such as the genus Kalmia, for example the genera and species Kalmia latifolia, Kalmia angustifolia, Kalmia microphylla, Kalmia polifolia, Kalmia occidentalis, Cistus chamaerhodendros or Kalmia lucida [mountain laurel], Euphorbiaceae such as the genera Manihot, Janipha, Jatropha, Ricinus, for example the genera and species Manihot utilissima, Janipha manihot, Jatropha manihot, Manihot aipil, Manihot dulcis, Manihot manihot, Manihot melanobasis, Manihot esculenta [manihot] or Ricinus communis [castor-oil plant], Fabaceae such as the genera Pisum, Albizia, Cathormion, Feuillea, Inga, Pithecolobium, Acacia, Mimosa, Medicajo, Glycine, Dolichos, Phaseolus, Soja, for example the genera and species Pisum sativum, Pisum arvense, Pisum humile [pea], Albizia berteriana, Albizia julibrissin, Albizia lebbeck, Acacia berteriana, Acacia littoralis, Albizia berteriana, Albizzia berteriana, Cathormion berteriana, Feuillea berteriana, Inga fragrans, Pithecellobium berterianum, Pithecellobium fragrans, Pithecolobium berterianum, Pseudalbizzia berteriana, Acacia julibrissin, Acacia nemu, Albizia nemu, Feuilleea julibrissin, Mimosa julibrissin, Mimosa speciosa, Sericanrda julibrissin, Acacia lebbeck, Acacia macrophylla, Albizia lebbek, Feuilleea lebbeck, Mimosa lebbeck, Mimosa speciosa [silk tree], Medicago sativa, Medicago falcata, Medicago varia [alfalfa], Glycine max Dolichos soja, Glycine gracilis, Glycine hispida, Phaseolus max, Soja hispida or Soja max [soybean], Funariaceae such as the genera Aphanorrhegma, Entosthodon, Funaria, Physcomitrella, Physcomitrium, for example the genera and species Aphanorrhegma serratum, Entosthodon attenuatus, Entosthodon bolanderi, Entosthodon bonplandii, Entosthodon californicus, Entosthodon drummondii, Entosthodon jamesonii, Entosthodon leibergii, Entosthodon neoscoticus, Entosthodon rubrisetus, Entosthodon spathulifolius, Entosthodon tucsoni, Funaria americana, Funaria bolanderi, Funaria calcarea, Funaria californica, Funaria calvescens, Funaria convoluta, Funaria flavicans, Funaria groutiana, Funaria hygrometrica, Funaria hygrometrica var. arctica, Funaria hygrometrica var. calvescens, Funaria hygrometrica var. convoluta, Funaria hygrometrica var. muralis, Funaria hygrometrica var. utahensis, Funaria microstoma, Funaria microstoma var. obtusifolia, Funaria muhlenbergii, Funaria orcuttii, Funaria plano-convexa, Funaria polaris, Funaria ravenelii, Funaria rubriseta, Funaria serrata, Funaria sonorae, Funaria sublimbatus, Funaria tucsoni, Physcomitrella californica, Physcomitrella patens, Physcomitrella readeri, Physco¬mitrium australe, Physcomitrium californicum, Physcomitrium collenchymatum, Physcomitrium coloradense, Physcomitrium cupuliferum, Physcomitrium drummondii, Physcomitrium eurystomum, Physcomitrium flexifolium, Physcomitrium hookeri, Physcomitrium hookeri var. serratum, Physcomitrium immersum, Physcomitrium kellermanii, Physcomitrium megalocarpum, Physcomitrium pyriforme, Physcomitrium pyriforme var. serratum, Physcomitrium rufipes, Physcomitrium sandbergii, Physcomitrium subsphaericum, Physcomitrium washingtoniense, Geraniaceae, such as the genera Pelargonium, Cocos, Oleum, for example the genera and species Cocos nucifera, Pelargonium grossularioides or Oleum cocois [coconut], Gramineae, such as the genus Saccharum, for example the genus and species Saccharum officinarum, Juglandaceae, such as the genera Juglans, Wallia, for example the genera and species Juglans regia, Juglans ailanthifolia, Juglans sieboldiana, Juglans cinerea, Wallia cinerea, Juglans bixbyi, Juglans californica, Juglans hindsii, Juglans intermedia, Juglans jamaicensis, Juglans major, Juglans microcarpa, Juglans nigra or Wallia nigra [walnut], Lauraceae, such as the genera Persea, Laurus, for example the genera and species Laurus nobilis [bay], Persea americana, Persea gratissima or Persea persea [avocado], Leguminosae, such as the genus Arachis, for example the genus and species Arachis hypogaea [peanut], Linaceae, such as the genera Linum, Adenolinum, for example the genera and species Linum usitatissimum, Linum humile, Linum austriacum, Linum bienne, Linum angustifolium, Linum catharticum, Linum flavum, Linum grandiflorum, Adenolinum grandiflorum, Linum lewisii, Linum narbonense, Linum perenne, Linum perenne var. lewisii, Linum pratense or Linum trigynum [linseed], Lythrarieae, such as the genus Punica, for example the genus and species Punica granatum [pomegranate], Malvaceae, such as the genus Gossypium, for example the genera and species Gossypium hirsutum, Gossypium arboreum, Gossypium barbadense, Gossypium herbaceum or Gossypium thurberi [cotton], Marchantiaceae, such as the genus Marchantia, for example the genera and species Marchantia berteroana, Marchantia foliacea, Marchantia macropora, Musaceae, such as the genus Musa, for example the genera and species Musa nana, Musa acuminata, Musa paradisiaca, Musa spp. [banana], Onagraceae, such as the genera Camissonia, Oenothera, for example the genera and species Oenothera biennis or Camissonia brevipes [evening primrose], Palmae, such as the genus Elacis, for example the genus and species Elaeis guineensis [oil palm], Papaveraceae, such as the genus Papaver, for example the genera and species Papaver orientale, Papaver rhoeas, Papaver dubium [poppy], Pedaliaceae, such as the genus Sesamum, for example the genus and species Sesamum indicum [sesame], Piperaceae, such as the genera Piper, Artanthe, Peperomia, Steffensia, for example the genera and species Piper aduncum, Piper amalago, Piper angustifolium, Piper auritum, Piper betel, Piper cubeba, Piper longum, Piper nigrum, Piper retrofractum, Artanthe adunca, Artanthe elongata, Peperomia elongata, Piper elongatum, Steffensia elongata [cayenne pepper], Poaceae, such as the genera Hordeum, Secale, Avena, Sorghum, Andropogon, Holcus, Panicum, Oryza, Zea (maize), Triticum, for example the genera and species Hordeum vulgare, Hordeum jubatum, Hordeum murinum, Hordeum secalinum, Hordeum distichon, Hordeum aegiceras, Hordeum hexastichon, Hordeum hexastichum, Hordeum irregulare, Hordeum sativum, Hordeum secalinum [barley], Secale cereale [rye], Avena sativa, Avena fatua, Avena byzantina, Avena fatua var. sativa, Avena hybrida [oats], Sorghum bicolor, Sorghum halepense, Sorghum saccharatum, Sorghum vulgare, Andropogon drummondii, Holcus bicolor, Holcus sorghum, Sorghum aethiopicum, Sorghum arundinaceum, Sorghum caffrorum, Sorghum cernuum, Sorghum dochna, Sorghum drummondii, Sorghum durra, Sorghum guineense, Sorghum lanceolatum, Sorghum nervosum, Sorghum saccharatum, Sorghum subglabrescens, Sorghum verticilliflorum, Sorghum vulgare, Holcus halepensis, Sorghum miliaceum, Panicum militaceum [millet], Oryza sativa, Oryza latifolia [rice], Zea mays [maize], Triticum aestivum, Triticum durum, Triticum turgidum, Triticum hybernum, Triticum macha, Triticum sativum or Triticum vulgare [wheat], Porphyridiaceae, such as the genera Chroothece, Flintiella, Petrovanella, Porphyridium, Rhodella, Rhodosorus, Vanhoeffenia, for example the genus and species Porphyridium cruentum, Proteaceae, such as the genus Macadamia, for example the genus and species Macadamia intergrifolia [macadamia], Prasinophyceae such as the genera Nephroselmis, Prasinococcus, Scherffelia, Tetraselmis, Mantoniella, Ostreococcus, for example the genera and species Nephroselmis olivacea, Prasinococcus capsulatus, Scherffelia dubia, Tetraselmis chui, Tetraselmis suecica, Mantoniella squamata, Ostreococcus tauri, Rubiaceae such as the genus Cofea, for example the genera and species Cofea spp., Coffea arabica, Coffea canephora or Coffea liberica [coffee], Scrophulariaceae such as the genus Verbascum, for example the genera and species Verbascum blattaria, Verbascum chaixii, Verbascum densiflorum, Verbascum lagurus, Verbascum longifolium, Verbascum lychnitis, Verbascum nigrum, Verbascum olympicum, Verbascum phlomoides, Verbascum phoenicum, Verbascum pulverulentum or Verbascum thapsus [mullein], Solanaceae such as the genera Capsicum, Nicotiana, Solanum, Lycopersicon, for example the genera and species Capsicum annuum, Capsicum annuum var. glabriusculum, Capsicum frutescens [pepper], Capsicum annuum [paprika], Nicotiana tabacum, Nicotiana alata, Nicotiana attenuata, Nicotiana glauca, Nicotiana langsdorffii, Nicotiana obtusifolia, Nicotiana quadrivalvis, Nicotiana repanda, Nicotiana rustica, Nicotiana sylvestris [tobacco], Solanum tuberosum [potato], Solanum melongena [eggplant], Lycopersicon esculentum, Lycopersicon lycopersicum, Lycopersicon pyriforme, Solanum integrifolium or Solanum lycopersicum [tomato], Sterculiaceae, such as the genus Theobroma, for example the genus and species Theobroma cacao [cacao] or Theaceae, such as the genus Camellia, for example the genus and species Camellia sinensis [tea]. In particular preferred plants to be used as transgenic plants in accordance with the present invention are oil fruit crops which comprise large amounts of lipid compounds, such as peanut, oilseed rape, canola, sunflower, safflower, poppy, mustard, hemp, castor-oil plant, olive, sesame, Calendula, Punica, evening primrose, mullein, thistle, wild roses, hazelnut, almond, macadamia, avocado, bay, pumpkin/squash, linseed, soybean, pistachios, borage, trees (oil palm, coconut, walnut) or crops such as maize, wheat, rye, oats, triticale, rice, barley, cotton, cassava, pepper, Tagetes, Solanaceae plants such as potato, tobacco, eggplant and tomato, Vicia species, pea, alfalfa or bushy plants (coffee, cacao, tea), Salix species, and perennial grasses and fodder crops. Preferred plants according to the invention are oil crop plants such as peanut, oilseed rape, canola, sunflower, safflower, poppy, mustard, hemp, castor-oil plant, olive, Calendula, Punica, evening primrose, pumpkin/squash, linseed, soybean, borage, trees (oil palm, coconut). Especially preferred are sunflower, safflower, tobacco, mullein, sesame, cotton, pumpkin/squash, poppy, evening primrose, walnut, linseed, hemp, thistle or safflower. Very especially preferred plants are plants such as safflower, sunflower, poppy, evening primrose, walnut, linseed, or hemp, or most preferred, plants of family Brassicaceae.

The invention is also concerned with providing constructs for establishing high content of VLC-PUFAs in plants or parts thereof, particularly in plant oils.

As such, the invention provides a T-DNA for expression of a target gene in a plant, wherein the T-DNA comprises a left and a right border element and at least one expression cassette comprising a promoter, operatively linked thereto a target gene, and downstream thereof a terminator, wherein the length of the T-DNA, preferably measured from left to right border element and comprising the target gene, has a length of at least 30000 bp. In an embodiment, the expression cassette is separated from the closest border of the T-DNA by a separator of at least

500 bp length. In another embodiment, the expression cassette is separated from the closest border of the T-DNA by a separator of at least 100 bp in length. In another embodiment, the expression cassette is separated from the closest border of the T-DNA by a separator of at least 200 bp in length.

Also, the invention relates to a construct comprising expression cassettes for various desaturase and elongase genes as described elsewhere herein in more detail.

As described elsewhere herein, the the T-DNA or construct of the present invention may comprise multiple expression cassettes encoding various, i.e. multiple proteins. In an embodiment, the T-DNA or construct of the present invention may comprise a separator between the expression cassettes encoding for the desaturases or elongases referred to above. In an embodiment, the expression cassettes are separated from each other by a separator of at least 100 base pairs, preferably they are separated by a separator of 100-200 base pairs. Thus, there is a separator between each expression cassette.

The invention thus provides nucleic acids, i.e. polynucleotides. A polynucleotide according to the present invention is or comprises a T-DNA according to the present invention. Thus, a T-DNA according to the present invention is a polynucleotide, preferably a DNA, and most preferably a double stranded DNA. A "T-DNA" according to the invention is a nucleic acid capable of eventual integration into the genetic material (genome) of a plant. The skilled person understands that for such integration a transformation of respective plant material is required, prefered transformation methods and plant generation methods are described herein.

According to the invention are also provided nucleic acids comprising a T-DNA or construct as defined according to the present invention. For example, a T-DNA or construct of the present invention may be comprised in a circular nucleic acid, e.g. a plasmid, such that an additional nucleic acid section is present between the left and right border elements, i.e. “opposite” of the expression cassette(s) according to the present invention. Such circular nucleic acid may be mapped into a linear form using an arbitrary starting point, e.g. such that the definition “left border element – expression cassette – right border element – additional nucleic acid section opposite of the expression cassette” defines the same circular nucleic acid as the definition “expression cassette – right border element – additional nucleic acid section opposite of the expression cassette – left border element”. The additional nucleic acid section preferably comprises one or more genetic elements for replication of the total nucleic acid, i.e. the nucleic acid molecule comprising the T-DNA and the additional nucleic acid section, in one or more host microorganisms, preferably in a microorganism of genus Escherichia, preferably E. coli, and/or Agrobacterium. Preferable host microorganisms are described below in more detail. Such circular nucleic acids comprising a T-DNA of the present invention are particularly useful as transformation vectors; such vectors and are described below in more detail.

The polynucleotides as referred to herein preferably are expressed in a plant after introducing them into a plant. Thus, the method of the present invention may also comprise the step of introducing the polynucleotides into the plant. Preferably, the polynucleotides are introduced into the plant by transformation, in particular by Agrobacterium-mediated transformation. In an embodiment, the plants are transformed with a construct or T-DNA comprising the polynucleotides and/or expression cassette as set forth in connection with the present invention such as the expression cassettes encoding for desaturase and elongase as shown in Table 11. Thus, it is envisaged that the plant is (has been) transformed with a T-DNA or construct of the present invention. The construct or T-DNA used for the introduction, preferably comprises all polynucleotides to be expressed. Thus, a single construct or T-DNA shall be used for transformation, in other words, the polynucleotides encoding for desaturases and elongases shall be comprised by the same T-DNA. It is to be understood, however, that more than one copy of the T-DNA may be comrprised by the plant.

The T-DNA length is preferably large, i.e. it has a minimum length of at least 30000 bp, preferably more than 30000 bp, more preferably at least 40000 bp, even more preferably at least 50000 bp and most preferably at least 60000 bp. Preferably, the length of the T-DNA is in a range of any of the aforementioned minimum lengths to 120000bp, more preferably in a range of any of the aforementioned minimum lengths to 100000bp, even more preferably in a range of any of the aforementioned minimum lengths to 90000 bp, even more preferably in a range of any of the aforementioned minimum lengths to 80000 bp. With such minimum lengths it is possible to introduce a number of genes in the form of expression cassettes such that each individual gene is operably liked to at least one promoter and at least one terminator. As is shown hereinafter in the examples section, the invention makes use of such minimum length T-DNA for introducing the genes required for the metabolic pathway of VLC-PUFA production in plants, e.g. oil seed plants, preferably plants of genus Brassica. Also, the length of the T-DNA is preferably limited as described before to allow for easy handling.

Moreover, the construct of the present invention may have a minimum length of at least 30000 bp, preferably more than 30000 bp, more preferably at least 40000 bp, even more preferably at least 50000 bp and most preferably at least 60000 bp.

In an embodiment, in 3' direction of the T-DNA left border element or in 5' direction of the T-DNA right border element, a separator is present setting the respective border element apart from the expression cassette comprising the target gene. The separator in 3' direction of the T-DNA left border element does not necessarily have the same length and/or sequence as the separator in 5' direction of the T-DNA right border element, as long as both separators suffice to the further requirements given below.

In another embodiment, the expression cassettes are separated from each other by a separator of at least 100 base pairs, preferably by a separator of 100 to 200 base pairs. Thus, there is a separator between the expression cassettes.

The separator or spacer is a section of DNA predominantly defined by its length. Its function is to separate a target gene from the T-DNA's left or right border, respectively. As will be shown in the examples, introducing a separator effectively separates the gene of interest from major influences exerted by the neighbouring genomic locations after insertion of the T-DNA into a genomic DNA. For example it is commonly believed that not all genomic loci are equally suitable for expression of a target gene, and that the same gene under the control of the same promoter and terminator may be expressed in different inensity in plants depending on the region of integration of the target gene (and its corresponding promoter and terminator) in the plant genome. It is generally believed that different regions of a plant genome are accessible with differing ease for transcription factors and/or polymerase enzymes, for example due to these regions being tightly wound around histones and/or attached to the chromosomal backbone (cf. for example Deal et al., Curr Opin Plant Biol. Apr 2011; 14(2): 116–122) or other scaffold material (cf. e.g. Fukuda Y., Plant Mol Biol. 1999 Mar; 39(5): 1051-62). The mechanism of achieving the above mentioned benefits by the T-DNA of the present invention is not easily understood, so it is convenient to think of the spacer as a means for physically providing a buffer to compensate for strain exerted by DNA winding by neighbouring histones or chromosomal backbone or other scaffold attached regions. As a model it can be thought that to transcribe a target gene, the DNA has to be partially unwound. If neighbouring regions of the target gene resist such unwinding, for example because they are tightly wound around histones or otherwise attached to a scaffold or backbone such that rotation of nucleic acid strands is limited, the spacer allows to distribute the strain created by the unwinding attempt over a longer stretch of nucleic acid, thereby reducing the force required for unwinding at the target gene.

In an embodiment, the separator has a length of at least 500 bp. The separator, thus, can be longer than 500 bp, and preferably is at least 800 bp in length, more preferably at least 1000 bp. Longer spacers allow for even more physical separation between the target gene and the nearest genomic flanking region.

In another embodiment, the spacer has a length of at least 100 bp. Preferably, the spacer has a length of 100 to 200 base pairs.

The separator preferably has a sequence devoid of matrix or scaffold attachment signals. Preferably, the separator or spacer is does not comprise more than once for a length of 500 bp, preferably not more than once for a length of 1000 bp, a 5-tuple which occurs in the spacers described below in the examples for 20 or more times, summarized over all spacers given in the examples. Those tuples are, in increasing frequency in the spacers given in the examples: AGCCT, CGTAA, CTAAC, CTAGG, GTGAC, TAGGC, TAGGT, AAAAA, AACGC, TTAGC, ACGCT, GCTGA, ACGTT, AGGCT, CGTAG, CTACG, GACGT, GCTTA, AGCTT, CGCTA, TGACG, ACGTG, AGCTG, CACGT, CGTGA, CGTTA, AGCGT, TCACG, CAGCT, CGTCA, CTAGC, GCGTC, TTACG, GTAGC, TAGCG, TCAGC, TAGCT, AGCTA, GCTAG, ACGTA, TACGT. By reducing the frequency of occurrence of one or more of the aforelisted tuples compared to the separators or spacers as given in the examples, a further increase in expression of a target gene in the T-DNA can be achieved.

The separator may contain a selectable marker. A selectable marker is a nucleic acid section whose presence preferably can be verified in seed without having to wait for the sprouting or full growth of the plant. Preferably the selectable marker conveys a phenotypical property to seed or to a growing plant, for example herbicide tolerance, coloration, seed surface properties (e.g. wrinkling), luminescence or fluorescence proteins, for example green fluorecent protein or luciferase. If for exhibiting the phenotypical feature an expression of a marker gene is required, then the separator correspondingly comprises the marker gene as selectable marker, preferably in the form of an expression cassette. Inclusion of a selectable marker in the separator is particularly advantageous since the marker allows to easily discard non-transformant plant material. Also, in such unexpected case where the T-DNA integrates in a location of the plant genome where the length and/or nucleobase composition of the spacer is insufficient to overcome gene silencing effects caused by the neighbouring genomic DNA, the selectable marker allows to easily discard such unfortunately badly performing exceptional transformants. Thus, preferably the separator comprises an expression cassette for expression of an herbicide tolerance gene. Such separator greatly reduces the chance of having to cultivate a transformant where silencing effects are so strong that even the expression of the selectable marker gene is greatly reduced or fully inhibited. According to the invention, the separator preferably does not comprise a desaturase or elongase gene, and also preferably does not comprise a promoter or operatively linked to a desaturase or elongase gene. Thus, the T-DNA of the present invention in preferred embodiments is useful for effective separation of the desaturase and elongase genes essential for the production of VLC-PUFAs from any influence of effects caused by neighbouring genomic plant DNA.

Another method of isolating T-DNAs from major influences exerted by the neighbouring genomic locations in is maximize the distance of the T-DNA insert from neighboring genes. In addition, disruption of neighboring genes could result in unexpected effects on the host plant. It is possible to determine the genomic insertion site of a T-DNA with various methods known to those skilled in the art, such as adapter ligation-mediated PCR as described in O'Malley et al. 2007 Nature Protocols 2(11):2910-2917. Such methods allow for the selection of transgenic plants where the T-DNA has been inserted at a desired distance away from endogenous genes. It is preferable to identify transgenic events where the T-DNA is more than 1000 bp away from a neighboring coding sequence. More prefereable, the T-DNA is 2500 bp away, and most preferably the T-DNA is 5000 or more bp away from the nearest coding sequence.

In an embodiment, the T-DNA or T-DNAs comprised by the plant of the present invention, thus, does not (do not) disrupt an endogenous coding sequence. Preferably, the T-DNA is (the T-DNAs are) more than 1000 bp away from a neighboring coding sequence. More prefereable, the T-DNA is (the T-DNAs are) 2500 bp away, and most preferably the T-DNA is (the T-DNAs are) 5000 or more bp away from the nearest coding sequence.

For the production of VLC-PUFAs in plants, the invention also provides a T-DNA or construct comprising the coding sequences of any single gene (in particular of the coding sequences for the desaturases and elongases) of the tables given in the examples, preferably comprising the coding sequences and and promoters of any single of the tables given in the examples, more preferably the coding sequences and promoters and terminators of any single of the tables given in the examples, and most preferably the expression cassettes of any single of the tables of the examples.

In an embodiment, the invention also provides a construct or a T-DNA comprising the coding sequences (in particular of the desaturases and elogases) as given in Table 11 and 130 in the examples, preferably comprising the coding sequences (in particular of the desaturases and elogases) and and promoters as given in Table 11 in the examples, more preferably the coding sequences (in particular of the desaturases and elogases) and promoters and terminators as given in Table 11 in the examples, and most preferably the expression cassettes for the desaturases and elongases as referred to in the context of the method of present invention as present in VC-LTM593-1qcz rc (see Examples section, SEQ ID NO: 3).

Also, the invention provides a T-DNA for production of VLC-PUFAs in a plant, wherein the T-DNA comprises a left and a right border element and in between one or more expression cassette(s), wherein the length of the T-DNA, measured from left to right border element and comprising the one or more expression cassettes, has a length of at least 30000 bp. In an embodiment, the expression cassette(s) closest to a left or right border element, respectively, is (are) separated from said closest border element of the T-DNA by a separator of at least 500 bp length. It is to be understood that the one or more expression cassette(s) each comprise a promoter, operatively linked to a target gene, and downstream thereof a terminator, wherein the target gene of a respective expression cassette is a desaturase or elongase gene as required for production of a VLC-PUFA. Preferably at least one and most preferably all of the target genes codes/code for a desaturase or elongase as given in any of the tables in the examples section, and further preferably at least one and most preferably all expression cassettes consist of a combination of promoter, desaturase/elongase gene and terminator as given in any of the examples below. In one embodiment a plant of the invention comprises one or more T-DNA of the present invention comprising one or more expression cassettes encoding for one or more d6Des (delta 6 desaturase), one or more d6Elo (delta 6 elongase), one or more d5Des (delta 5 desaturase), one or more o3Des (omega 3 desaturase), one or more d5Elo (delta 5 elongase) and one or more D4Des (delta 4 desaturase), preferably for at least one CoA-dependent D4Des and one Phospholipid-dependent d4Des. In one embodiment, the T-DNA encodes also for one or more d12Des (delta 12 desaturase). In an embodiment, the desaturases and elongases are derived from the organisms disclosed above. In one embodiment, a plant of the invention thus comprises one or more T-DNA of the present invention comprising at least one polynucleotide encoding a delta-6-desaturase (preferably a CoA-dependent delta-6-desaturase), at least two polynucleotides encoding a delta-6-elongase, at least two polynucleotides encoding a delta-5-desaturase, at least one polynucleotide encoding a delta-12-desaturase, at least three polynucleotides encoding an omega-3-desaturase, and at least one polynucleotide encoding a delta-5-elongase, and at least two polynucleotides encoding a delta-4-desaturase (preferably at least one for a CoA-dependent D4Des and at least one for Phospholipid-dependent d4Des).

Preferred polynucleotide sequences encoding for the desaturases and elongases referred to above are disclosed elsewherein herein (see also SEQ ID Nos in Table 130).

In a particular preferred embodiment, the desaturases and elongases are from the organisms disclosed above. In one embodiment, a plant of the invention thus comprises one or more T-DNA of the present invention comprising at least one polynucleotide encoding a delta-6-desaturase, at least two polynucleotides encoding a delta-6-elongase, at least two polynucleotides encoding a delta-5-desaturase, at least one polynucleotide encoding a delta-12-desaturase, at least three polynucleotides encoding an omega-3-desaturase, and at least one polynucleotide encoding a delta-5-elongase, and at least two polynucleotides encoding a delta-4-desaturase (preferably for at least one CoA-dependent D4Des and one Phospholipid-dependent d4Des).

In a further preferred embodiment of the present invention, a plant of the invention comprises one or more T-DNA of the present invention comprising one expression cassette for a delta-6 elongase from Physcomitrella patens, one expression cassette for a delta-6 elongase from Thalassiosira pseudonana, two expression cassettes for a delta-5 desaturase from Thraustochytrium sp. (in particular from Thraustochytrium sp. ATCC21685), two expression cassettes for an omega-3 desaturase from Pythium irregulare, one expression cassette for a omega-3-desaturase from Phythophthora infestans, one expression cassette for a delta-5 elongase from Ostreococcus tauri, one expression cassette for a delta-4 desaturase from Thraustochytrium sp., and one expression cassette for a delta-4 desaturase from Pavlova lutheri. The sequences of polynucleotides encoding the desaturases or elongases can be found in in the T-DNA vector VC-LTM593-1qcz (SEQ ID NO: 3). For more information, see also Table 11. In an even further preferred embodiment, a plant of the invention comprises one or more T-DNA, wherein the T-DNA comprises the expression cassettes for the desaturases and elongases of VC-LTM593-1qcz (see e.g. Table 11). Moreover, it is envisaged that the plant of the present invention comprises one or more T-DNA of the present invention, wherein the T-DNA has the sequence of the T-DNA of the vector VC-LTM593-1qcz. The position of the T-DNA in the vector is indicated in Table 11. The vector has a sequence shown in SEQ ID NO: 3.

In a preferred embodiment, the T-DNA, construct, or plant of the present invention comprises polynucleotides encoding for the following desaturases and elongases, in particular in the following order: Delta-6 ELONGASE from Physcomitrella patens; Delta-5 DESATURASE from Thraustochytrium (in particular from Thraustochytrium sp. ATCC21685); Delta-6 DESATURASE from Ostreococcus tauri; Delta-6 ELONGASE from Thalassiosira pseudonana; Delta-12 DESATURASE from Phythophthora sojae; Omega-3 DESATURASE from Pythium irregulare; Omega-3-DESATURASE from Phythophthora infestans; Delta-5 DESATURASE from Thraustochytrium (in particular from Thraustochytrium sp. ATCC21685); Delta-4 DESATURASE from Thraustochytrium sp.; Omega-3 DESATURASE from Pythium irregular; Delta-4 DESATURASE from Pavlova lutheri; Delta-5 ELONGASE from Ostreococcus tauri. Thus, T-DNA, construct, or plant of the present invention comprises two copies of a Delta-5 desaturase from Thraustochytrium and two copies of Delta-5 desaturase from Thraustochytrium. Also encompassed are variants thereof.

As set forth elsewhere herein, the T-DNA preferably shall have a length of at least 30000 bp.

In one embodiment, the plant of the invention or a part thereof as described herein comprises one or more T-DNAs of the invention which encode for at least two d6Des, at least two d6Elo and/or, at least two o3Des. In one embodiment, the present plant of the invention or a part thereof comprise a T-DNA comprising one or more expression cassettes encoding for at least one CoA-dependent d4Des and at least one phopho-lipid dependent d4Des. In one embodiment the activities of the enzymes expressed by the one or more T-DNAs in the plant of the invention or a part thereof are encoded and expressed polpeptides having the activities shown in column 1 of Table 19. In one embodiment the plant of the invention comprises at least one T-DNA as shown in columns 1 to 9 in Table 13. In one embodiment, one T-DNA of the present invention comprises one or more gene expression cassettes encoding for the activities or enzymes listed in Table 13.

In one embodiment, the at least one T-DNA further comprises an expression cassette which encodes for at least one d12Des. In one embodiemt, the T-DNA or T-DNAs comprise one or more expression cassettes encoding one or more d5Des(Tc_GA), o3Des(Pir_GA), d6Elo(Tp_GA) and/or d6Elo(Pp_GA). Such plants of the present invention have shown particularly high amounts and concentrations of VLC-PUFAs over three or more generations and under different growth conditions.

In one embodiment the T-DNA of the invention encodes for the activites of column 1 as disclosed in Table 19, preferably of gene combinations disclosed in Table 13, even more preferred for promoter-gene combinations as described in Table 13.

The contribution from each desaturase and elongase gene present in the T-DNA to the amount of VLC-PUFA is difficult to assess, but it is possible to calculate conversion efficiencies for each pathway step, for example by using the equations shown in Figure 2. The calculations are based on fatty acid composition of the tissue or oil in question and indicate the amount of product fatty acid (and downstream products) formed from the subatrate of a particular enzyme. The conversion efficiencies are sometimes referred to as “apparent” conversion efficiencies because for some of the calculations it is recognized that the calculations do not take into account all factors that could be influencing the reaction. Nevertheless, conversion efficiency values can be used to assess contribution of each desaturase or elongase reaction to the overall production of VLC-PUFA. By comparing conversion efficiencies, one can compare the relative effectiveness of a given enzymatic step between different individual seeds, plants, bulk seed batches, events, Brassica germplasm, or transgenic constructs.

In an embodiment of the present invention, the plant is a Brassica napus plant. Preferably, the plant comprises at least one T-DNA of the invention (and thus one or more T-DNAs). The T-DNA shall have a length of at least at least 10.000 base pairs, in particular of at least 30.000 bp.

As set forth elsewhere herein, the T-DNA comprised by the invention shall comprise expression cassettes for desaturases and elongases. In an embodiment, the T-DNA comprises one or more expression cassettes for a delta-5 desaturase (preferably one), one or more expression cassettes for a omega-3 desaturase (preferably three), one or more expression cassettes for a delta 12 desaturase (preferably one), one or more expression cassettes for a delta 4 desaturase (preferably one CoA-dependent d4des and one phospholipid dependent d4des), one or more expression cassettes for a delta-5 elongase (preferably one), one or more expression cassettes for a delta-6 desaturase (preferably one), and one or more expression cassettes for a delta-6 elongase (preferably two). Preferably, the T-DNA comprises two expression cassettes for a delta-5 desaturase from Thraustochytrium sp., two expression cassettes for an omega-3-desaturase from Phythophthora infestans, one expression cassette for an omega-3-desaturase from Pythium irregulare, one expression cassette for a delta-12 desaturase from Phythophthora sojae, one expression cassette for a Delta-4 desaturase from Pavlova lutheri, one expression cassette for a Delta-4 desaturase from Thraustochytrium sp., one expression cassette for a Delta-6 desaturase from Ostreococcus tauri, one expression cassette for a Delta-6 elongase from Physcomitrella patens, and one expression cassette for a Delta-6 elongase from Thalassiosira pseudonana. The SEQ ID Nos are given in Table 130. Further, it is envisaged that expression cassettes for variants of the aforementioned enzymes may be used.

The plant shall produce an oil as described elsewhere herein in more detail:

In connection with the present invention is envisaged, that the plant has one or more of the following features:

(i) A delta 6 desaturase conversion efficiency in bulk seed of greater than about 28%, or greater than about 34%, or greater than about 40%,

(ii) A delta 6 desaturase conversion efficiency in a single seed of greater than about 40%,

(iii) A delta 6 elongase conversion efficiency in bulk seed of greater than about 75%, or greater than about 82%, or greater than about 89%,

(iv) A delta 6 elongase conversion efficiency in single seed of greater than about 86%,

(v) The T-DNA insert or inserts do not disrupt an endogenous coding sequence (as described elsewhere herein),

(vi) The distance between any inserted T-DNA sequence and the nearest endogenous gene is about 1000, or about 2000, or about 5000 base pairs,

(vii) The T-DNA insert or inserts do not cause rearrangements or any DNA surrounding the insertion location,

(viii) No partial T-DNA inserts (Thus, the full length T-DNA shall be integrated in the genome),

(ix) The T-DNA insert or inserts occur exclusively in the C genome of Brassica,

(x) All inserted transgenes are fully functional (thus, the enzymes encoded by the genes shall retain their function).

How to calculate conversion efficiencies for a delta-6-desaturase of a delta 6-elongase is well known in the art. In an embodiment, the conversion efficiencies are calculated by using the equations shown in Figure 2. Moreover, it is envisaged that conversion efficiencies are calculated as described in Examples 19 to 22.

As described in detail in the examples, with regards to the production of VLC-PUFAs three desaturase genes are particularly prone to gene dosage effects (also called “copy number effects”), such that increasing the number of expression cassettes comprising these respective genes leads to a stronger increase in VLC-PUFA levels in plant oils than increasing the number of expression cassettes of other genes. These genes are the genes coding for delta-12-desaturase activity, for delta-6-desaturase activity and omega-3-desaturase activity. Thus, according to the invention each expression cassette comprising a gene coding for a delta-12-desaturase, delta-6-desaturase or omega-3-desaturase is separated from the respective closest left or right border element by a separator and optionally one or more expression cassettes. It is to be understood that where the T-DNA of the present invention comprises more than one expression cassette comprising a gene of the same function, these genes do not need to be identical concerning their nucleic acid sequence or the polypeptide sequence encoded thereby, but should be functional homologs. Thus, for example, to make use of the gene dosage effect described herein a T-DNA according to the present invention may comprise, in addition to optionally a multiplicity of genes coding for delta-6-desaturases and/or omega-3-desaturases, two, three, four or more expression cassettes each comprising a gene coding for a delta-12-desaturase, wherein the delta-12-desaturase polypeptides coded by the respective genes differ in their amino acid sequence. Likewise, a T-DNA of the present invention may comprise, in addition to optionally a multiplicity of genes coding for delta-12-desaturases and/or omega-3-desaturases, two, three, four or more expression cassettes each comprising a gene coding for a delta-6-desaturase, wherein the delta-6-desaturase polypeptides coded by the respective genes differ in their amino acid sequence, or a T-DNA of the present invention may comprise, in addition to optionally a multiplicity of genes coding for delta-12-desaturases and/or delta-6-desaturases, two, three, four or more expression cassettes each comprising a gene coding for a omega-3-desaturase, wherein the omega-3-desaturase polypeptides coded by the respective genes differ in their amino acid sequence.

According to the invention, the T-DNA, construct or plant may also comprise, instead of one or more of the aforementioned coding sequences, a functional homolog thereof. A functional homolog of a coding sequence is a sequence coding for a polypeptide having the same metabolic function as the replaced coding sequence. For example, a functional homolog of a delta-5-desaturase would be another delta-5-desaturase, and a functional homolog of a delta-5-elongase would be another delta-5-elongase. The functional homolog of a coding sequence preferably codes for a polypeptide having at least 40% sequence identity to the polypeptide coded for by the corresponding coding sequence given in the corresponding table of the examples, more preferably at least 41%, more preferably at least 46%, more preferably at least 48%, more preferably at least 56%, more preferably at least 58%, more preferably at least 59%, more preferably at least 62%, more preferably at least 66%, more preferably at least 69%, more preferably at least 73%, more preferably at least 75%, more preferably at least 77%, more preferably at least 81%, more preferably at least 84%, more preferably at least 87%, more preferably at least 90%, more preferably at least 92%, more preferably at least 95%, more preferably at least 96%, more preferably at least 97%, more preferably at least 98% and even more preferably at least 99%. Likewise, a functional homolog of a promoter is a sequence for starting transcription of a coding sequence located within 500 bp for a proximal promoter or, for a distal promoter, within 3000 bp distant from the promoter TATA box closest to the coding sequence. Again, a functional homolog of a plant seed specific promoter is another plant seed specific promoter. The functional homolog of a terminator, correspondingly, is a sequence for ending transcription of a nucleic acid sequence.

The examples describe particularly preferred T-DNA sequences. As described above, the skilled person understands that the coding sequences, promoters and terminators described therein can be replaced by their functional homologs. However, the examples also describe that according to the invention, certain combinations of promoters and coding sequences, or certain combinations of promoters driving the expression of their corresponding coding sequences, or certain coding sequences or combinations thereof are particularly advantageous; such combinations or individual coding sequences should according to the invention not be replaced by functional homologs of the respective element (here: coding sequence or promoter).

A T-DNA or construct of the present invention preferably comprises two or more genes, preferably all genes, susceptible to a gene dosage effect. As described herein, it is advantageous for achieving high conversion efficiencies of certain enzymatic acitvities, e.g. delta-12-desaturase, delta-6-desaturase and/or omega-3-desaturase activity, to introduce more than one gene coding for an enzyme having the desired activity into a plant cell. When introducing T-DNA into plant cells, generally transformation methods involving exposition of plant cells to microorganisms are employed, e.g. as described herein. As each microorganism may comprise more than one nucleic acid comprising a T-DNA of the present invention, recombinant plant cells are frequently obtained comprising two or more T-DNAs of the present invention independently integrated into the cell's genetic material. Thus, by combining genes susceptible to a gene dosage effect on one construct for transformation allows to easily exploit the independence of transformations to achieve a higher frequency of multiple insertions of such T-DNAs. This could be e.g. useful for transformation methods relying on co-transformation to keep the size of each construct to be transformed low.

The invention accordingly also provides a construct comprising a T-DNA according to the present invention, wherein the construct preferably is a vector for transformation of a plant cell by microorganism-mediated transformation, preferably by Agrobacterium-mediated transformation. Correspondingly, the invention also provides a transforming microorganism comprising one T-DNA according to the present invention, preferably as a construct comprising said T-DNA. Preferably the microorganism is of genus Agrobacterium, preferably a disarmed strain thereof, and preferably of species Agrobacterium tumefaciens or, even more preferably, of species Agrobacterium rhizogenes. Corresponding strains are for example described in WO06024509A2, and methods for plant transformation using such microorganisms are for example described in WO13014585A1. These WO publications are incorporated herein in their entirety, because they contain valuable information about the creation, selection and use of such microorganisms.

The term "vector", preferably, encompasses phage, plasmid, viral vectors as well as artificial chromosomes, such as bacterial or yeast artificial chromosomes. Moreover, the term also relates to targeting constructs which allow for random or site-directed integration of the targeting construct into genomic DNA. Such target constructs, preferably, comprise DNA of sufficient length for either homologous or heterologous recombination as described in detail below. The vector encompassing the polynucleotide of the present invention, preferably, further comprises selectable markers for propagation and/or selection in a host. The vector may be incorporated into a host cell by various techniques well known in the art. If introduced into a host cell, the vector may reside in the cytoplasm or may be incorporated into the genome. In the latter case, it is to be understood that the vector may further comprise nucleic acid sequences which allow for homologous recombination or heterologous insertion. Vectors can be introduced into prokaryotic or eukaryotic cells via conventional transformation or transfection techniques. The terms "transformation" and "transfection", conjugation and transduction, as used in the present context, are intended to comprise a multiplicity of prior-art processes for introducing foreign nucleic acid (for example DNA) into a host cell, including calcium phosphate, rubidium chloride or calcium chloride co-precipitation, DEAE-dextran-mediated transfection, lipofection, natural competence, carbon-based clusters, chemically mediated transfer, electroporation or particle bombardment. Suitable methods for the transformation or transfection of host cells, including plant cells, can be found in Sambrook et al. (Molecular Cloning: A Laboratory Manual, 2nd ed., Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989) and other laboratory manuals, such as Methods in Molecular Biology, 1995, Vol. 44, Agrobacterium protocols, Ed.: Gartland and Davey, Humana Press, Totowa, New Jersey. Alternatively, a plasmid vector may be introduced by heat shock or electroporation techniques. Should the vector be a virus, it may be packaged in vitro using an appropriate packaging cell line prior to application to host cells.

Preferably, the vector referred to herein is suitable as a cloning vector, i.e. replicable in microbial systems. Such vectors ensure efficient cloning in bacteria and, preferably, yeasts or fungi and make possible the stable transformation of plants. Those which must be mentioned are, in particular, various binary and co-integrated vector systems which are suitable for the T DNA-mediated transformation. Such vector systems are, as a rule, characterized in that they contain at least the vir genes, which are required for the Agrobacterium-mediated transformation, and the sequences which delimit the T-DNA (T-DNA border). These vector systems, preferably, also comprise further cis-regulatory regions such as promoters and terminators and/or selection markers with which suitable transformed host cells or organisms can be identified. While co-integrated vector systems have vir genes and T-DNA sequences arranged on the same vector, binary systems are based on at least two vectors, one of which bears vir genes, but no T-DNA, while a second one bears T-DNA, but no vir gene. As a consequence, the last-mentioned vectors are relatively small, easy to manipulate and can be replicated both in E. coli and in Agrobacterium. These binary vectors include vectors from the pBIB-HYG, pPZP, pBecks, pGreen series. Preferably used in accordance with the invention are Bin19, pBI101, pBinAR, pGPTV and pCAMBIA. An overview of binary vectors and their use can be found in Hellens et al, Trends in

Plant Science (2000) 5, 446–451. Furthermore, by using appropriate cloning vectors, the polynucleotides can be introduced into host cells or organisms such as plants or animals and, thus, be used in the transformation of plants, such as those which are published, and cited, in: Plant Molecular Biology and Biotechnology (CRC Press, Boca Raton, Florida), chapter 6/7, pp. 71-119 (1993); F.F. White, Vectors for Gene Transfer in Higher Plants; in: Transgenic Plants, vol. 1, Engineering and Utilization, Ed.: Kung and R. Wu, Academic Press, 1993, 15-38; B. Jenes et al., Techniques for Gene Transfer, in: Transgenic Plants, vol. 1, Engineering and Utilization, Ed.: Kung and R. Wu, Academic Press (1993), 128-143; Potrykus 1991, Annu. Rev. Plant Physiol. Plant Molec. Biol. 42, 205-225.

More preferably, the vector of the present invention is an expression vector. In such an expression vector, i.e. a vector which comprises the polynucleotide of the invention having the nucleic acid sequence operatively linked to an expression control sequence (also called "expression cassette") allowing expression in prokaryotic plant cells or isolated fractions thereof.

Most important, the invention also provides a plant or seed thereof, comprising, integrated in its genome, a T-DNA or a construct of the present invention.

Thus, the construct or T-DNA shall be stably integrated into the genome of the plant or plant cell. In an embodiment, the plant is homozygous for the T-DNA. In another embodiment, the plant is hemizygous for the T-DNA. If the plant is homozygous for one T-DNA at one locus, this is nevertheless considered as a single copy herein, i.e. as one copy. Double copy, as used herein, refers to a plant in which two T-DNAs have been inserted, at one or two loci, and in the hemizygous or homozygous state.

Stability of the T-DNA can be assessed by determining the presence of the T-DNA in two or more subsequent generations of a transgenic event. Determining the presence of a T-DNA can be achieved by Southern blot analysis, PCR, DNA sequencing, or other methods that are suitable for the detection of specific DNA sequences. Stability of the T-DNA should also include copy number measurements for transgenic events that contain more than one copy of the T-DNA. In this case, instability of a single copy of the T-DNA may not be detectable by selecting for the trait, *i.e.* VLC-PUFA conent, because the presence of one stable T-DNA copy may mask the instability of the other. When working with large T-DNAs of at least 30000 bp in length, and with multiple copies of certain sequences (for example two copies of the same promoter) it is especially important to confirm presence and copy number at multiple locations within the T-DNA. The borders of a long T-DNA have an increased likelihood of being in linkage equilibrium, and duplicated sequences increase the possibility of homologous recombination. The effects of being in linkage equilibrium, and the potential for homologous recombination, mean that transgenes of a T-DNA could be disrupted or lost over generations. Therefore, it is preferred to test for the presence and copy number of a large T-DNA (at least 30000 bp) at more than three locations on the T-DNA, including a region at the right and left borders as well as a region internal to the T-DNA. It is more preferred to test for the presence and copy number of more than 5 regions, and most preferred to test presence and copy number of at least 7 regions on the T-DNA.

Such T-DNA or construct preferably allows for the expression of all genes required for production of VLC-PUFAs in plants and particularly in the seeds thereof, particularly in oilseed plants, and most beneficially in plants or seeds of family Brassicaceae, preferably of genus Brassica and most preferably of a species comprising a genome of one or two members of the species Brassica oleracea, Brassica nigra and Brassica rapa, thus preferably of the species Brassica napus, Brassica carinata, Brassica juncea, Brassica oleracea, Brassica nigra or Brassica rapa. Particularly preferred according to the invention are plants and seeds of the species Brassica napus and Brassica carinata.

The plants of the present invention are necessarily transgenic, i.e. they comprise genetic material not present in corresponding wild type plant or arranged differently in corresponding wild type plant, for example differing in the number of genetic elements. For example, the plants of the present invention comprise promoters also found in wild type plants, but the plants of the present invention comprise such promoter operatively linked to a coding sequence such that this combination of promoter and coding sequence is not found in the corresponding wild type plant. Accordingly, the polynucleotide encoding for the desaturases or elongases shall be recombinant polynucleotides.

The plants and seeds of the present invention differ from hitherto produced plants for production of VLC-PUFAs in a number of advantageous features, some of which are described in detail in the examples. In particular, T-DNAs of the present invention allow for the generation of transformant plants (also called "recombinant plants") and seeds thereof with a high transformation frequency, with a high stability of T-DNA insertions over multiple generations of self-fertilized plants, unchanged or unimpaired phenotypical and agronomic characteristics other than VLC-PUFA production, and with high amounts and concentration of VLC-PUFAs, particularly EPA and/or DHA, in the oil of populations of such transformed plants and their corresponding progeny.

Seed-to-seed variability and plant-to-plant variability in VLC-PUFA amounts per seed are high even for identical clones cultivated side by side under identical greenhouse conditions. Also, it has now been found and is reported below in the examples that the contentration of VLC-PUFAs is negatively correlated with seed oil content in Brassica napus. The mere statement of VLC-PUFA concentration in %(w/w) of all fatty acids of a plant oil is not indicative of the VLC-PUFA amount achievable by agricultural (i.e. large scale) growing of corresponding clones.VLC-PUFA amounts or concentrations depends on which genes, promoters, gene-promoter combinations, gene-gene combinations etc. are beneficial for VLC-PUFA synthesis in oilseed plants. Different classes of seed groupings based on the seeds used to generate that group are: (i) “individual seed” or “single seed” refers to one seed from one plant. (ii) seed derived from a “individual plant” refers to all seeds grown on a single plant without effort to select based on seed-to-seed variability. (iii) “batches of seed” or “seedbatches” refers to all of the seeds collected from a specific number of plants without selection based on plant-to-plant or seed-to-seed variability. The specific number of plants referred to in a batch can be any number, one or greater, where it is understood that a batch of one plant is equivalent to individual plant. (iv) “bulked seed” refers

to all of the seed gathered from a large number of plants (equal to or greater than 100) without effort to select seeds based on plant-to-plant or seed-to-seed variability.
Also, it is important to note that VLC-PUFA amounts or concentrations can indeed be increased by increasing the number of expression cassettes of functionally identical genes. And it is also important to note that even though many prior art documents purport to comprise applicable technical teachings, e.g. to combine desaturases having a particular property, e.g. CoA-dependence, it is not known how to reduce such alleged technical teachings to practice, particularly as such documents only teach requirements (i.e. functional claim features) but not solutions for these requirements (i.e. structural features). For example, such prior art documents frequently comprise only one example of a single gene and leave the reader with the instruction to start a research program to find other enzymes satisfying the functional definition given therein, provided that any other enzyme exists that satisfies those functional requirements.

Unless stated otherwise, a plant of the present invention comprising a T-DNA or construct of the present invention can also be a plant comprising a part of a T-DNA or construct of the present invention, where such part is sufficient for the production of a desaturase and/or elongase coded for in the corresponding full T-DNA or construct of the present invention. Such plants most preferably comprise at least one full T-DNA or construct of the present invention in addition to the part of a T-DNA of the present invention as defined in the previous sentence. Such plants are hereinafter also termed "partial double copy" plants. Event LBFDAU is an example of a plant comprising a part of a T-DNA of the present invention, and still being a plant of the present invention. In one embodiment the T_DNA is a full T-DNA.

Preferred plants of the present invention comprise one or more T-DNA(s) or construct of the present invention comprising expression cassettes comprising, one or more genes encoding for one or more d5Des, one or more d6Elo, one or more d6Des, one or more o3Des, one or more d5Elo and one or more D4Des, preferably for at least one CoA-dependent D4Des and one Phospholipid-dependent d4Des. In one embodiment, at least one T-DNA further comprises an expression cassette which encodes for at least one d12Des. In one embodiemt, the T-DNA or T-DNAs further comprise one or more expression cassettes encoding one or more d5Des(Tc_GA), o3Des(Pir_GA), d6Elo(Tp_GA) and/or d6Elo(Pp_GA), an explanation for the abbreviation in the brackets is given e.g. in Table 130, e.g. d6Elo(Tp_GA) is a Delta-6 elongase from *Thalassiosira pseudonana,* d6Elo(Pp_GA) i a Delta-6 elongase from *Physcomitrella patens.* Such plants of the present invention have shown particularly high amounts and concentrations of VLC-PUFAs over three or more generations and under different growth conditions.

Preferred plants according to the invention are oilseed crop plants.

Most preferably, the plant of the present invention is a plant found in the "Triangle of U", i.e. a plant of genus Brassica: Brassica napus (AA CC genome; n=19) is an amphidiploid plant of the Brassica genus but is thought to have resulted from hybridization of Brassica rapa (AA genome; n=10) and Brassica oleracea (CC genome; n=9). Brassica juncea (AA BB genome; n=18) is an amphidiploid plant of the Brassica genus that is generally thought to have resulted from the hybridization of Brassica rapa and Brassica nigra (BB genome; n=8). Under some growing conditions, B. juncea may have certain superior traits to B. napus. These superior traits may include higher yield, better drought and heat tolerance and better disease resistance. Brassica carinata (BB CC genome; n=17) is an amphidiploid plant of the Brassica genus but is thought to have resulted from hybridization of Brassica nigra and Brassica oleracea. Under some growing conditions, B. carinata may have superior traits to B. napus. Particularly, B. carinata allows for an increase in VLC-PUFA concentrations by at least 20% compared to B. napus when transformed with the same T-DNA.

The plant of the present invention preferably is a "Canola" plant. Canola is a genetic variation of rapeseed developed by Canadian plant breeders specifically for its oil and meal attributes, particularly its low level of saturated fat. Canola herein generally refers to plants of Brassica species that have less than 2% erucic acid (Delta 13-22:1) by weight in seed oil and less than 30 micromoles of glucosinolates per gram of oil free meal. Typically, canola oil may include saturated fatty acids known as palmitic acid and stearic acid, a monounsaturated fatty acid known as oleic acid, and polyunsaturated fatty acids known as linoleic acid and linolenic acid. Canola oil may contain less than about 7%(w/w) total saturated fatty acids (mostly palmitic acid and stearic acid) and greater than 40%(w/w) oleic acid (as percentages of total fatty acids). Traditionally, canola crops include varieties of Brassica napus and Brassica rapa. Preferred plants of the present invention are spring canola (Brassica napus subsp. oleifera var. annua) and winter canola (Brassica napus subsp. oleifera var. biennis). Furthermore a canola quality Brassica juncea variety, which has oil and meal qualities similar to other canola types, has been added to the canola crop family (U.S. Pat. No. 6,303,849, to Potts et al., issued on Oct. 16, 2001; U.S. Pat. No. 7,423,198, to Yao et al.; Potts and Males, 1999; all of which are incorporated herein by reference). Likewise it is possible to establish canola quality B. carinata varieties by crossing canola quality variants of Brassica napus with Brassica nigra and appropriately selecting progeny thereof, optionally after further back-crossing with B. carinata, B. napus and/or B. nigra.

The invention also provides a plant or seed thereof of family Brassicaceae, preferably of genus Brassica, with a genotype that confers a heritable phenotype of seed oil VLC-PUFA content, obtainable or obtained from progeny lines prepared by a method comprising the steps of

i) crossing a plant of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, said plant comprising a T-DNA or construct of the present invention and/or part of such T-DNA, with a parent plant of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, said plant not comprising said T-DNA and/or part thereof, to yield a F1 hybrid,

ii) selfing the F1 hybrid for at least one generation, and

iii) identifying the progeny of step (ii) comprising the T-DNA of the present invention capable of producing seed comprising VLC-PUFA.

Preferably, the progeny are capable of producing seed comprising an oil as described elsewhere herein (in particular, see the definition for the oil of the present invention). More preferably, the progeny shall be capable of producing seed comprising VLC-PUFA such that the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 12% (w/w) and/or the content of DHA is at least 2% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w). Also preferably, the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 5%, in particular at least 8% (w/w) and/or the content of DHA is at least 1% (w/w), in particular 1.5% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w).

This method allows to effectively incorporate genetic material of other members of family Brassicaceae, preferably of genus Brassica, into the genome of a plant comprising a T-DNA or construct of the present invention. The method is particularly useful for combining a T-DNA or construct of the present invention with genetic material responsible for beneficial traits exhibited in other members of family Brassicaceae. Beneficial traits of other members of family Brassicaceae are exemplarily described herein, other beneficial traits or genes and/or regulatory elements involved in the manifestation of a beneficial trait may be described elsewhere.

The parent plant not comprising the T-DNA or contruct of the present invention or part thereof preferably is an agronomically elite parent. In particular, the present invention teaches to transfer heterologous material from a plant or seed of the present invention to a different genomic background, for example a different variety or species.

In particular, the invention teaches to transfer the T-DNA or part thereof (the latter is particularly relevant for those plants of the present invention which comprise, in addition to a full T-DNA of the present invention, also a part of a T-DNA of the present invention, said part preferably comprising at least one expression cassette, the expression cassette preferably comprising a gene coding for a desaturase or elongase, preferably a delta-12-desaturase, delta-6-desaturase and/or omega-3-desaturase), or construct into a species of genus Brassica carinata, or to introduce genetic material from Brassica carinata or Brassica nigra into the plants of the present invention comprising the T-DNA of the present invention and/or a part or two or more parts thereof. According to the invention, genes of Brassica nigra replacing their homolog found in Brassica napus or added in addition to the homolog found in Brassica napus are particularly helpful in further increasing the amount of VLC-PUFAs in plant seeds and oils thereof.

Also, the invention teaches novel plant varieties comprising the T-DNA and/or part thereof of the present invention. Such varieties can, by selecting appropriate mating partners, be particularly adapted e.g. to selected climatic growth conditions, herbicide tolerance, stress resistance, fungal resistance, herbivore resistance, increased or reduced oil content or other beneficial features. As shown hereinafter in the examples it is particularly beneficial to provide plants of the present invention wherein the oil content thereof at harvest is lower than that of corresponding wild type plants of the same variety, such as to improve VLC-PUFA amounts in the oil of said plants of the present invention and/or VLC-PUFA concentrations in said oil.

Also, the invention provides a method for creating a plant with a genotype that confers a heritable phenotype of seed oil VLC-PUFA content, obtainable or obtained from progeny lines prepared by a method comprising the steps of

i) crossing a transgenic plant of the invention with a parent plant not comprising a T-DNA of the present invention or part thereof, said parent plant being of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, to yield a F1 hybrid,
ii) selfing the F1 hybrid for at least one generation, and
iii) identifying the progeny of step (ii) comprising the T-DNA of the present invention capable of producing seed comprising VLC-PUFA.

Preferably, the progeny are capable of producing seed comprising an oil as described elsewhere herein (in particular the oil of the present invention). More preferably, the progeny shall be capable of producing seed comprising VLC-PUFA such that the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 8% (w/w) and/or the content of DHA is at least 1% (w/w) of the total seed fatty acid content at an oil content of 30% (w/w), preferably at an oil content of 35% (w/w), and more preferably at an oil content of 40% (w/w).

The method allows the creation of novel variants and transgenic species of plants of the present invention, and the seeds thereof. Such plants and seeds exhibit the aforementioned benefits of the present invention. Preferably, the content of EPA is at least 5%, more preferably at least 8%, even more preferably at least 10% by weight, most preferably at least 13% (w/w), of the total lipid content of the oil. Also preferably, the content of DHA is at least 1.0% by weight, more preferably at least 1.5%, even more preferably at least 2% (w/w), of the total lipid content of the oil. The present invention for the first time allows to achieve such high levels of VLC-PUFA in seed reliably under agronomic conditions, i.e. representative for the real yield obtained from seeds of a commercial field of at least 1 ha planted with plants of the present invention, wherein the plants have a defined copy number of genes for implementing the pathway for production of EPA and/or DHA in said plants, and the copy number being low, i.e. single-copy or partial double copy.

A plant of the present invention also includes plants obtainable or obtained by backcrossing (cross into the non-transgenic, isogenic parent line), and by crossing with other germplasms of the Triangle of U. Accordingly, the invention provides a method for creating a plant with a genotype that confers a heritable phenotype of seed oil VLC-PUFA content, obtainable or obtained from a progeny line prepared by a method comprising the steps of

i) crossing a transgenic plant of the invention (also called “non-recurring parent”) with a parent plant not expressing a gene comprised in the T-DNA of the present invention, said parent plant being of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, to yield a hybrid progeny,
ii) crossing the hybrid progeny again with the parent to obtain another hybrid progeny,
iii) optionally repeating step ii) and

iv) selecting a hybrid progeny comprising the T-DNA of the present invention.

Backcrossing methods, e.g. as described above, can be used with the present invention to improve or introduce a characteristic into the plant line comprising the T-DNA of the present invention. Such hybrid progeny is selected in step iv) which suffices predetermined parameters. The backcrossing method of the present invention thereby beneficially facilitates a modification of the genetic material of the recurrent parent with the desired gene, or preferably the T-DNA of the present invention, from the non-recurrent parent, while retaining essentially all of the rest of the desired genetic material of the recurrent parent, and therefore the desired physiological and morphological, constitution of the parent line. The selected hybrid progeny is then preferably multiplied and constitutes a line as described herein. Selection of useful progeny for repetition of step ii) can be further facilitated by the use of genomic markers. For example, such progeny is selected for the repetition of step ii) which comprises, compared to other progeny obtained in the previous crossing step, most markers also found in the parent and/or least markers also found in the non-recurring parent except the desired T-DNA of the present invention or part thereof.

Preferably, a hybrid progeny is selected which comprises the T-DNA of the present invention, and even more preferably also comprises at least one further expression cassette from the non-recurring parent of the present invention, e.g. by incorporation of an additional part of the T-DNA of the present invention into the hybrid plant genetic material.

Further preferably a hybrid progeny is obtained wherein essentially all of the desired morphological and physiological characteristics of the parent are recovered in the converted plant, in addition to genetic material from the non-recurrent parent as determined at the 5% significance level when grown under the same environmental conditions.

Further preferably, a hybrid progeny is selected which produces seed comprising an oil as described elsewhere herein (i.e. an oil of the present invention). In particular, a hybrid progeny is selected which produces seed comprising VLC-PUFA such that the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 8% (w/w) and/or the content of DHA is at least 1% (w/w) of the total seed fatty acid content at an oil content of 30% (w/w), preferably at an oil content of 35% (w/w), and more preferably at an oil content of 40% (w/w).

It is to be understood that such seed VLC-PUFA content is to be measured not from a single seed or from the seeds of an individual plant, but refer to the numeric average of seed VLC-PUFA content of at least 100 plants, even more preferably of at least 200 plants, even more preferably of at least 200 plants half of which have been grown in field trials in different years, in particular ofbulked seed VLC-PUFA content of at least 100 plants, even more preferably of at least 200 plants, even more preferably of at least 200 plants half of which have been grown in field trials in different years.

The choice of the particular non-recurrent parent will depend on the purpose of the backcross. One of the major purposes is to add some commercially desirable, agronomically important trait to the line.
The term "line" refers to a group of plants that displays very little overall variation among individuals sharing that designation. A "line" generally refers to a group of plants that display little or no genetic variation between individuals for at least one trait. A "DH (doubled haploid) line," as used in this application refers to a group of plants generated by culturing a haploid tissue and then doubling the chromosome content without accompanying cell division, to yield a plant with the diploid number of chromosomes where each chromosome pair is comprised of two duplicated chromosomes. Therefore, a DH line normally displays little or no genetic variation between individuals for traits. Lines comprising one or more genes originally comprised in a T-DNA of the present invention in the non-recurring parent also constitute plants of the present invention.

The invention is also concerned with a method of plant oil production, comprising the steps of
i) growing a plant of the present invention such as to obtain oil-containing seeds thereof,
ii) harvesting said seeds, and
iii) extracting oil from said seeds harvested in step ii).

Preferably, the oil is an oil as described herein below in more detail (i.e. an oil of the present invention). More preferably, the oil has a DHA content of at least 1% by weight based on the total lipid content and/or a EPA content of at least 8% by weight based on the total lipid content. Also preferably, the oil has a DHA content of at least 1% by weight based on the total fatty acid content and/or a EPA content of at least 8% by weight based on the total fatty acid content.

Again preferably, the content of EPA is at least 10% by weight, even more preferably at least 13% (w/w), of the total lipid content of the oil. Also preferably, the content of DHA is at least 1.5% by weight, even more preferably at least 2% (w/w), of the total lipid content of the oil. As described herein, the plant of the present invention comprises, for the purposes of such method of plant oil production, preferably comprises a T-DNA (or construct) of the present invention and optionally also one or more additional parts thereof, wherein the part or parts, respectively, comprise at least one expression cassette of the T-DNA of the present invention.

The invention is also concerned with parts of plants of the present invention. The term “parts of plants” includes anything derived from a plant of the invention, including plant parts such as cells, tissues, roots, stems, leaves, non-living harvest material, silage, seeds, seed meals and pollen. Preferably such plant part comprises a T-DNA of the present invention and/or comprises a content of EPA of at least 8% by weight, more preferably at least 10%, even more preferably at least 13% (w/w), of the total lipid content. Also preferably, the content of DHA is at least 1.0% by weight, more preferably at least 1.5%, even more preferably at least 2% (w/w), of the total lipid content of the plant part. Parts of plants of the present invention comprising, compared to wild-type plants, elevated content of EPA and/or DHA, or the oil or lipid of the present invention are particularly useful also for feed purposes, e.g. for aquaculture feed, e.g. as described in AU2011289381A and members of the patent family thereof.

The plants of the present invention do not necessarily have to comprise a complete T-DNA of the present invention. As described above, by crossing (or back-crossing) methods it is possible to transfer arbitrary genetic material of one line to another line. Thus, by applying such crossing or back-crossing it is possible to transfer one or more, even all, expression cassettes comprised in a plant of the present invention (such plant comprising a T-DNA of the present invention) to another plant line, thereby losing e.g. a left or right border element (or both) and/or a spacer.

Thus, the invention also provides plants comprising genetic material hybridizing to a primer as given in Example 24.

Also, the invention provides plants comprising a heterologous nucleic acid segment inserted in its genetic material. The insertion is according to the invention in one of the below listed flanking regions or between a pair of flanking regions. Due to plant-to-plant variability, each flanking region may differ from the below indicated flanking regions by at most 10% calculated over a consecutive stretch of at least 100nt, preferably by at most 5% calculated over a consecutive stretch of at least – with increasing percentage identity more preferred - 90. 91. 92, 93, 94, 95, 96, 97, 98 or 99, preferred 100% identity for 100 nt. Even more preferably, the flanking region(s) comprise at least – with increasing percentage identity more preferred - 90. 91. 92, 93, 94, 95, 96, 97, 98 or 99, preferred 100% identity for 50 consecutive nucleotides identical to a fragment of a flanking region as given below, even more preferable the length of consecutive identical nucleotides is at least 100.

Example 24 provides an overview of all the flanking sequences of all loci obtained for each event listed in that table. In addition, event specific primers and probes are disclosed in Table 176 for event specific detection. The method for using those primers and probes is described in example 24.

As shown in the examples, insertions in these flanking regions have now been proven to lead to a surprisingly high production of VLC-PUFAs in seed, wherein such production is stable over many generations and under different growth conditions. Thus, insertion of other genetic material at these insertion locations also leads to a stable, high expression of inserted genes compared to insertions at other positions of the plant genome.

The invention is also concerned with establishing and optimizing efficient metabolic VLC-PUFA synthesis pathways. To this end, the invention provides a method for analysing desaturase reaction specificity, comprising the steps of

i) providing, to a desaturase, a detectably labelled molecule comprising a fatty acid moiety and a headgroup,
ii) allowing the desaturase to react on the labelled molecule, and
iii) detecting desaturation products.

The labelled molecule preferably is a fatty acid-coenzyme A or a fatty acid-phospholipid, the latter preferably being a lysophosphatidylcholine bound fatty acid. The method advantageously allows to determining desaturase headgroup preference or even headgroup specificity by detecting whether coenzyme A bound fatty acids are desaturated and/or whether phospholipid-bound fatty acids are desaturated.

Preferably the desaturase is provided as a microsomal fraction of an organism, preferably of yeast. Transgenic yeasts expressing the desaturase in question are easy to prepare and handle, and microsomal fractions comprising functional desaturases can be reliably and reproducibly prepared thereof without major burden. Microsomal fractions, particularly of yeast, most preferably of Saccharomyces cerevisiae, also allow to convert fatty acid-coenzyme A molecules to fatty acids bound to other headgroups by using the yeast's native LPCAT. Likewise, microsomal fractions can be prepared from other cells and organisms.

Preferably the molecule is detectably labelled by including a radioactive isotope instead of a non-radioactive isotope. The isotope preferably is [14C]. Such label is easy to detect, does not interefere in biochemical reactions and can be incorporated in virtually any carbon-containing molecule, thereby allowing sensitively detecting and characterizing any desaturation product.

The fatty acid moiety preferably is a PUFA moiety, more preferably a VLC-PUFA moiety and most preferably a VLC-PUFA moiety. This way, the headgroup preference or specificity for economically important desaturases can be determined without having to resort to error prone and laborious feeding of live organisms or living cells.

The desaturase is allowed to react on the labelled molecule. If the desaturase can accept the labelled molecule as a substrate, then the desaturation reaction is performed. Preferably, the method is repeated by including, as a positive control, a labelled molecule which had been confirmed to be a substrate for the desaturase.

Detection preferably is accomplished using chromatography, most preferably thin layer chromatography. This technique is well known to the skilled person, readily available, very sensitive and allows differentiating even between very similar molecules. Thus, even if the positive control molecule is similar to the molecule of interest, a clear detection of desaturation products (if desaturation of the molecule occurred) is still possible.

The above method allows preparing a collection of specificity data for each desaturase, type of microsomal fraction (e.g. from yeast, plant cells etc.), fatty acid moiety and headgroup. Thus, the method can be used to select a desaturase for a given need, e.g. to accept CoA-bound fatty acids in plant cells for further presentation to an elongase. The method also allows establishing substrate specificty of the desaturase in an organism or organ of interest, e.g. a yeast, a plant leaf cell or a plant seed cell.

The invention also provides a method for analysing elongase reaction specificity, comprising the steps of

i) providing, to an elongase, a detectably labelled elongation substrate and a molecule to be elongated,
ii) allowing the elongase to elongate the molecule to be elongated using the labelled elongation substrate, and
iii) detecting elongation products.

Unless stated otherwise, the method for analysing elongase reaction specificity is performed corresponding to the method for analysing desaturase reaction specificity for corresponding reasons. The elongation substrate preferably is malonyl-CoA. The elongation substrate is preferably labelled radioactively, most preferably [14C] malonyl-CoA. Radioactive labelling allows for an easy and sensitive detection of elongation products. Also, labelling of the elongation substrate instead of the molecule to be elongated allows presenting a mixture of molecules to be elongated to the elongase, and only the elongation products will have incorporated significant amounts of label to render them easily detectable. Thus, in a single reaction vessel a multitude of potential molecules to be elongated can be assayed to determine which of these molecules are indeed elongated, and the relative affinity of the elongase to the respective molecule.

By combining both methods, it is possible to analyse even complex sequences of desaturation and elongation reactions. The invention thus also provides a method for pathway optimization, comprising the steps of

i) providing enzymes of a metabolic pathway and one or more substrates to be used by the first enzyme or enzymes of the pathway,
ii) reacting the enzymes and the substrates to produce products, which in turn are also exposed as potential substrates to the enzymes of the pathway, and
iii) determining the accumulation of products.

The method particularly allows providing desaturases and elongases to form a pathway. This is useful to determine the yield of product(s) of the pathway and of any unwanted side products. Also, by providing two or more different enzymes which perform the same metabolic function, e.g. a particular desaturation step, e.g. a delta-5 desaturation, it is possible to analyse if the presence of more than one type of enzymes has an effect on product formation, particularly on product formation rate. For such analysis, one would compare the results with a method performed with only one of the at least two enzymes. Thus, if addition of enzymes performing the same metabolic function leads to an increased yield or product formation rate, then this metabolic step is subject to a gene dosage effect. To optimize the pathway in an organism one would correspondingly strive to implement the pathway step using the two or more enzymes as required.

Also, the method advantageously allows determining the mode of action of an enzyme in question. To this end, a helper enzyme is provided to produce a substrate for a target enzyme. The helper enzyme's mode of action is known. The helper enzyme is then provided with a substrate to turn into a product which could be used as a substrate of the target enzyme.

Generation of product by the target enzyme is determined, preferably by measuring the amount of product per time or the final amount of product divided by the amount of substrate converted by the helper enzyme. Then the method is repeated using a helper enzyme of a different mode of action, and generation of product by the target enzyme is determined, too. By comparing the product generation by the target enzyme for each mode of action, the mode of action of the target enzyme is defined as being the mode of action of the helper enzyme giving rise to the most intense generation of product by the target enzyme.

For example, to determine the mode of action of a target desaturase, a helper elongase is provided for which it has been text book knowledge that it is utilizing acyl CoA substrate and produces acyl-CoA products. Then, product generation by the target desaturase is measured. In another step, a helper desaturase is provided for which it has been established that it produces phosphatidylcholine-bound fatty acids. Again, product generation by the target desaturase is measured. When comparing the product generation of the target desaturase, the target desaturase can be defined as being a CoA-dependent desaturase if the product generation of the target desaturase under conditions where CoA-bound fatty acids are provided by the helper enzyme is more intense (e.g. higher conversion efficiency) than under conditions where phosphatidylcholine-bound fatty acids are provided by the helper enzyme.

Thus, the invention also provides a method for determining CoA-dependence of a target desaturase, comprising the steps of

i) providing an elongase to produce a substrate for the target desaturase, and determining conversion efficiency of the target desaturase, and
ii) providing a non-CoA dependent desaturase to produce the substrate for the target desaturase, and determining conversion efficiency of the target desaturase, and
iii) comparing the target desaturase conversion efficiencies of step i) and ii).

If the conversion efficiency of the target desaturase is larger in step i) than in step ii), then the target desaturase is CoA-dependent. Of course, both steps must be performed under comparable conditions; particularly a substrate limitation of the target desaturase must be avoided.

The method can also be performed by providing an elongase which uses the substrate of the target desaturase. Thus, the invention provides a method for determining CoA-dependence of a target desaturase, comprising the steps of

i) providing an elongase to elongate the products of the target desaturase, and determining conversion efficiency of the elongase,
ii) providing the elongase to elongate the products of a comparison desaturase known to be non-CoA dependent, and determining conversion efficiency of the elongase,
iii) comparing the elongase conversion efficiencies of step i) and ii).

If the elongase conversion efficiency is higher in step i) than in step ii), the target desaturase is CoA-dependence. Without being bound by any particular theory it is presently expected that in such case the desaturation product does not have to be converted into an elongatable CoA-bound fatty acid, thus desaturated product can be immediately utilized by the elongase without accumulation. Of course, both steps must be performed under comparable conditions; particularly a substrate limitation of the elongase must be avoided.

The present invention also relates to oil comprising a polyunsaturated fatty acid obtainable by the aforementioned methods. In addition, the present invention also relates to a lipid or fatty acid composition comprising a polyunsaturated fatty acid obtainable by the aforementioned methods.

The term “oil” refers to a fatty acid mixture comprising unsaturated and/or saturated fatty acids which are esterified to triglycerides. Preferably, the triglycerides in the oil of the invention comprise PUFA or VLC-PUFA moieties as referred to above. The amount of esterified PUFA and/or VLC-PUFA is, preferably, approximately 30%, a content of 50% is more preferred, a content of 60%, 70%, 80% or more is even more preferred. The oil may further comprise free fatty acids, preferably, the PUFA and VLC-PUFA referred to above. For the analysis, the fatty acid content can be, e.g., determined by GC analysis after converting the fatty acids into the methyl esters by transesterification. The content of the various fatty acids in the oil or fat can vary, in particular depending on the source. The oil, however, shall have a non-naturally occurring composition with respect to the PUFA and/or VLC-PUFA composition and content. It is known that most of the fatty acids in plant oil are esterified in triacylglycerides. Accordingly, in the oil of the invention, the PUFAs and VLC-PUFAs are, preferably, also occur in esterified form in the triacylglcerides. It will be understood that such a unique oil composition and the unique esterification pattern of PUFA and VLC-PUFA in the triglycerides of the oil shall only be obtainable by applying the methods of the present invention specified above. Moreover, the oil of the invention may comprise other molecular species as well. Specifically, it may comprise minor impurities (and thus minor amounts) of the polynucleotide or vector of the invention. which however, can be detected only by highly sensitive techniques such as PCR.

As described above, these oils, lipids or fatty acids compositions, preferably, comprise 4 to 15% of palmitic acid (in an embodiment 6 to 15% of palmitic acid), 1 to 6% of stearic acid, 7-85% of oleic acid, 0.5 to 8% of vaccenic acid, 0.1 to 1% of arachidic acid, 7 to 25% of saturated fatty acids, 8 to 85% of monounsaturated fatty acids and 60 to 85% of polyunsaturated fatty acids, in each case based on 100% and on the total fatty acid content of the organisms (preferably by weight). Preferred VLC-PUFAs present in the fatty acid esters or fatty acid mixtures is, preferably, at least 5,5% to 20% of DHA and/or 9,5% to 30% EPA based on the total fatty acid content (preferably by weight).

The oils, lipids or fatty acids according to the invention, preferably, comprise at least 1%, 1.5%, 2%, 3%, 4%, 5.5%, 6%, 7% or 7,5%, more preferably, at least 8%, 9%, 10%, 11% or 12%, and most preferably at least 13%,14%,15%,16%. 17%, 18%, 19% or 20% of DHA (preferably by weight), or at least 5%, 8%, 9.5%, 10%, 11% or 12%, more preferably, at least 13%, 14%, 14,5%, 15% or 16%, and most preferably at least 17%,18%,19%,20%. 21%, 22%, 23%, 24%, 25%, 26%, 27%, 28%, 29% or 30% of EPA (preferably by weight) based on the total fatty acid content of the production host cell, organism, advantageously of a plant, especially of an oil crop such as soybean, oilseed rape, coconut, oil palm, safflower, flax, hemp, castor-oil plant, Calendula, peanut, cacao bean, sunflower or the abovementioned other monocotyledonous or dicotyledonous oil crops. In an embodiment, the oils, lipids or fatty acids according to the invention, preferably, comprise at least 1% of DHA, and/or at least 8% of EPA based on the total fatty acid content of the production host cell, organism, advantageously of a plant, especially of an oil crop such as soybean, oilseed rape, coconut, oil palm, safflower, flax, hemp, castor-oil plant, Calendula, peanut, cacao bean, sunflower or the abovementioned other monocotyledonous or dicotyledonous oil crops.

Preferably, the oil, lipid or fatty acid composition of the present invention is a plant oil, plant lipid, or plant fatty acid composition. Preferably, said oil or lipid is extracted, obtained, obtainable or produced from a plant, more preferably from seeds of a plant or plants (in particular a plant or plants of the present invention). The oil or lipid thus can be obtained by the methods of the present invention. In particular, the plant oil or plant lipid is an extracted plant oil or lipid. Also preferably, said oil or lipid is extracted, obtained, obtainable or produced from a plant, more preferably from batches of seeds or bulked seeds of a plant or plants (in particular a plant or plants of the present invention).

Preferably, the term “extracted” in connection with an oil or lipid refers to an oil or lipid that has been extracted from a plant, in particular from seeds of a plant or plants. More preferably, the term “extracted” in connection with an oil or lipid refers to an oil or lipid that has been extracted from a plant, in particular from batch of seeds or bulked seeds of a plant or plants. Such oil or lipid can be a crude composition. However, it may be also a purified oil or lipid in which e.g. the water has been removed. In an embodiment, the oil or lipid is not blended with fatty acids from other sources.

The oil or lipid of the present invention may be also an oil or lipid in a seed of plant. Preferably, said plant is a transgenic plant. More preferably, said plant is a plant of the present invention. In a particular preferred embodiment, the plant is a Brassica plant.

The oil or lipid of the present invention shall comprise fatty acids. In particular, the oil or lipid shall comprise fatty acids in esterified form. Thus, the fatty acids shall be esterified. Preferably, the oil or lipid of the present comprises one or more of following fatty acids (in esterified form): Oleic acid (OA), Linoleic acid (LA), gamma-Linolenic acid (GLA), alpha-Linolenic acid (ALA), Stearidonic acid (SDA), 20:2n-9 ((Z,Z)-8,11-Eicosadienoic acid), Mead acid (20:3n-9), Dihomo-gamma-linolenic acid (DHGLA), Eicosapentaenoic acid (Timnodonic acid, EPA, 20:5n-3), Clupanodonic acid (DPA n-3), and DHA ((Z,Z,Z,Z,Z,Z)-4,7,10,13,16,19-Docosahexaenoic acid). More preferably, the oil or lipid comprises EPA, DHA and Mead acid. Even more preferably, the oil or lipid comprises EPA, DHA, Mead acid, DPA n-3, and DHGLA. Most preferably, the oil or lipid comprises fatty acids mentioned in this paragraph.

It is in particular envisaged that the oil or lipid of the present invention comprises both EPA and DHA. Preferred contents of EPA and DHA are given elsewhere herein.

Further, it is envisaged that the oil or lipid comprises EPA, DHA, and DPA n-3. In an embodiment, the oil or lipid further comprises Mead Acid.

Also, it is envisaged that the oil or lipid comprises EPA, DHA, and DHGLA. In an embodiment, the oil or lipid further comprises Mead Acid.

In addition, the oil or lipid may comprise EPA, DHA, DPA n-3, and DHGLA. In an embodiment, the oil or lipid further comprises Mead Acid.
Thus, the expression cassettes, the construct or the T-DNA of the present invention can be used for modulating, in particular increasing, the content of one or more of the aforementioned fatty acids in plants, in seeds and/or in seed oil of a plant as compared to a control plant.

The preferred content of aforementioned fatty acids in the total fatty acid content of the lipid or oil of the present invention is further described in the following. In the following, ranges are given for the contents. The content (levels) of fatty acids are expressed as percentage (weight of a particular fatty acid) of the (total weight of all fatty acids), in particular of the (total weight of all fatty acids present in the oil or lipid). The contents are thus, preferably given as weight percentage (% (w/w)) of total fatty acids present in the oil or lipid. Accordingly, "%" preferably means "% (w/w)" for a fatty acid (or combination of fatty acids) compared to the total weight of fatty acids".

Preferably, the fatty acids are present in esterified form. Thus, the fatty acids shall be esterified fatty acids.

Preferably, the oil or lipid comprises Oleic acid (OA). Preferably, the content of Oleic acid (OA) is between 10% and 45%, more preferably between 20% and 38%, most preferably between 26% and 32% of the total fatty acid content.

Preferably, the oil or lipid comprises Linoleic acid (LA). Preferably, the content of Linoleic acid (LA) is between 5% and 40%, more preferably between 10% and 40%, most preferably between 20% and 35% of the total fatty acid content.

Preferably, the oil or lipid comprises gamma-Linolenic acid (GLA). Preferably, the content of gamma-Linolenic acid (GLA) is between 0.1% and 6%, more preferably between 0.1% and 3%, most preferably between 0.5% and 2% of the total fatty acid content.
Preferably, the oil or lipid comprises alpha-linolenic acid (ALA). Preferably, the content of alpha-Linolenic acid (ALA) is between 2% and 20%, more preferably between 4% and 10%, most preferably between 4% and 7% of the total fatty acid content.

Preferably, the oil or lipid comprises Stearidonic acid (SDA). Preferably, the content of Stearidonic acid (SDA) is between 0.1% and 10%, more preferably between 0.1% and 5%, most preferably between 0.1% and 1% of the total fatty acid content.

The content of SDA was surprisingly low. In an embodiment, the content of SDA is lower than 2%, in particular lower than 1%.

Preferably, the oil or lipid comprises 20:2n-9. Preferably, the content of 20:2n-9 ((Z,Z)-8,11-Eicosadienoic acid) is between 0.1% and 3%, more preferably between 0.1% and 2%, most preferably between 0.1% and 1% of the total fatty acid content.

Preferably, the oil or lipid comprises Mead acid (20:3n-9). Preferably, the content of Mead acid (20:3n-9) is between 0.1% and 2%, more preferably between 0.1% and 1%, most preferably between 0.1% and 0.5% of the total fatty acid content. In another embodiment, the content of Mead acid (20:3n-9) is between 0.1% and 0.3% of the total fatty acid content

Preferably, the oil or lipid comprises Dihomo-gamma-linolenic acid (DHGLA). Preferably, the content of Dihomo-gamma-linolenic acid (DHGLA) is between 0.1% and 10%, more preferably between 1% and 6%, most preferably between 1% and 5%, in particular between 2 and 4% of the total fatty acid content. The accumulation of this internmediate was not necessarily expected.

Preferably, the oil or lipid comprises EPA (20:5n-3). Preferably, the content of Eicosapentaenoic acid (Timnodonic acid, EPA, 20:5n-3) is between 0.1% and 20%, more preferably between 2% and 15%, most preferably between 5% and 10% of the total fatty acid content.

Further, it is envisaged that the content of EPA is between 5% and 15% of the total fatty acid content

Preferably, the oil or lipid comprises Clupanodonic acid (DPA n-3). Preferably, the content of Clupanodonic acid (DPA n-3) is between 0.1% and 10%, more preferably between 1% and 6%, most preferably between 2% and 4% of the total fatty acid content. In addition, the content of DPA n-3 may be at least 2% of the total fatty acids.

Preferably, the oil or lipid comprises DHA. Preferably, the content of DHA is between 1% and 10%, more preferably between 1% and 4%, most preferably between 1% and 2% of the total fatty acid content.

Further, it is envisaged that the content of DHA is between 1% and 3% of the total fatty acid content
In a preferred embodiment, the oil or lipid of the invention has a content of DHA between 1% and 4% and a content of EPA between 2% and 15% of the total fatty acid content. In another preferred embodiment, the oil or lipid of the invention has a content of DHA between 1% and 3% and a content of EPA between 5% and 15% of the total fatty acid content.

In another preferred embodiment, the oil or lipid of the invention has a content of DHA between 1% and 2% and a content of EPA between 5% and 10% of the total fatty acid content.

The oil or lipid of the present invention may also comprise saturated fatty acids such as 16:0 (Palmitic acid) and/or 18:0 (Stearic acid). The contents of 16:0 and 18:0 are advantageoulsly low as compared to wild-type plants. Low saturated fat is a desireable feature from the health perspective.

Thus, the oil or lipid may comprise 16:0. Preferably, the content of 16:0 is less than 6% of the total fatty acid content. More preferably, the content of 16:0 is between 3% and 6% of the total fatty acid content

Thus, the oil or lipid may comprise 18:0. Preferably, the content of 18:0 is less than 4%, in particular less than 3% of the total fatty acid content. More preferably, the content of 18:0 is between 1.5% and 4%, in particular between 2% and 3% of the total fatty acid content.

In an embodiment of the oil or lipid of the present invention, the total content of EPA, DHA and DPA n-3 is preferably more than 6% and the content of SDA is lower than 2% of all fatty acids present in the oil or lipids. More preferably the content of EPA, DHA, and DPA n-3 is between 7% and 14% and the content of SDA is lower than 1% of all fatty acids present in the oil or lipids.

In another preferred embodiment of the oil or the lipid of the present invention, the content of DPA n-3 is preferably at least 2% of the total fatty acid content, and the total content of EPA and DHA is at least 3% of the total fatty acid content. More preferably the content of DPA n-3 is between 2% and 5%, and the total content of EPA and DHA is between 6% and 12% of all fatty acids present in the oil or lipids.

In an embodiment of the oil or the lipid of the present invention, the content of 16:0 is preferably lower than 6% of the total fatty acid content, and the total content of EPA and DHA is at least 3% of the total fatty acid content. More preferably the content of 16:0 is between 2% and 6%, and the total content of EPA and DHA is between 6% and 12% of all fatty acids present in the oil or lipids.

In an embodiment of the oil or the lipid of the present invention, the content of 16:0 is preferably lower than 5% of the total fatty acid content, and the total content of EPA, DHA, DPA n-3 is at least 6% of the total fatty acid content. More preferably content of 16:0 is between 2% and 5% and the total content of EPA, DHA, and DPA is between 8% and 14% of all fatty acids present in the oil or lipids.
Interestingly, the content of EPA of the total fatty acids in the seeds, in particular in the seed oil, was larger than the content of DHA. This is not always the case; see for examples US2015/0299676A1 and WO 2015/089587. Thus, it is in particular envisaged, that the oil and lipid of the present invention comprises more EPA than DHA. Thus, the content of EPA shall be larger than the content of DHA. Preferably, the content of EPA of the total fatty acid acid content is 3 to 7-fold the content of DHA of the total fatty acid content. More preferably, the content of EPA of the total fatty acid acid content is 4 to 5-fold the content of DHA of the total fatty acid content.

Preferably, the total content of all omega-3 polyunsaturated [n-3 (C18-C22)] fatty acids is between 1% and 40%, more preferably between 10% and 30%, most preferably between 15% and 22% of the total fatty acid content.

Also preferably, the total content of all omega-6 polyunsaturated [n-6 (C18-C22)] fatty acids is between 0.1% and 50%, more preferably between 20% and 50%, most preferably between 37% and 42% of the total fatty acid content.

The oil or lipid of the present invention may comprise fatty acids that are non-naturally occurring in wild type control *Brassica napus* lipid or oil, preferably greater than 10%, more preferably between 12% and 25.2%, and most preferably between 16% and 25.0% of the total fatty acid content. Preferably, non naturally occurding fatty acids are 18:2n-9, GLA, SDA, 20:2n-9, 20:3n-9, 20:3 n-6, 20:4n-6, 22:2n-6, 22:5n-6, 22:4n-3, 22:5n-3, and 22:6n-3. Thus, the total content of these fatty acids in the oil or lipid of the present invention is preferably greater than 10%, more preferably between 12% and 25.2%, and most preferably between 16% and 25.0% of the total fatty acid content

In Example 32 it is shown that certain TAG (triacylglyceride) species were decreased and certain TAG species were increased in the seeds of the plants of the present invention (in particular in seed oil extracted from plants of the present invention).

The five most abundant TAG (triacylglyceride) species in wild-type Kumilly plants were TAG (18:1 18:1 18:3), TAG (18:1 18:2 18:3), TAG (18:1 18:1 18:2), TAG (18:1 18:1 18:1), and (TAG 18:1 18:2 18:2). Together, these account for 64.5% of all TAG species (in oil of wild-type plants). These species are specifically reduced in plants of the present invention (see Example 32, Table 192). The two most abundant DHA containing TAG species in the transgenic canola samples were TAG (18:1 18:2 22:6) and TAG (18:2 18:2 22:6). Interestingly, the EPA and DHA are found most frequently esterified to TAG together with 18:1 and 18:2. This makeup is likely to be more oxidatively stable that TAG species containing multiple PUFAs (see Wijesundra 2008, Lipid Technology 20(9):199-202). For more details, see Example 32 and table 192.

The oil or lipid of the present invention thus may comprise certain TAG species. Preferably, the oil or lipid comprises one or more of the following TAG species: TAG (18:1 18:2 20:5), TAG (18:1 18:1 20:5), TAG (18:2 18:2 20:5), TAG (18:1 18:2 22:6) and TAG (18:2 18:2 22:6). More preferably, the oil of lipid of the present invention comprises all of the aforementioned TAG species. Alternatively or additionally, the oil or lipid of the present invention may comprise TAG (18:1 18:1 22:6).

The triacylglyceride nomenclature used herein is well known in the art and well understood by the skilled person. The triacylglyceride TAG (x^1:y^1 x^2:y^2 x^3:y^3) is preferably denoted to mean that the triacylglyceride comprises three fatty acid ester residues, wherein one fatty acid ester residue is x^1:y^1 which means that this residue comprises x^1 carbon atoms and y^1 double bonds, wherein one fatty acid ester residue is x^2:y^2 which means that this residue comprises x^2 carbon atoms and y^2 double bonds, and wherein one fatty acid ester residue is x^3:y^3 which means that this residue comprises x^3 carbon atoms and y^3 double bonds. Preferably, any of these fatty acid ester residues may be attached to any former hydroxyl groups of the glycerol.

The preferred content of aforementioned TAG species of the total TAG content of the lipid or oil of the present invention is further described in the following. In the following ranges are given for the contents. The content (levels) of TAGs are expressed as percentage (weight of a particular TAG, or a combinations of TAGs) of the total weight of total TAGs (i.e. all TAGs) present in the oil or lipid). The contents are thus, preferably, given as weight percentage (% (w/w)). Accordingly, "%" preferably means "% (w/w) for a TAG (or combination of TAGs) compared to the total weight of TAGs".

Preferably, the oil or lipid comprises TAG (18:1 18:2 20:5). Preferably, the content of TAG (18:1 18:2 20:5) is between 0.1% and 20%, more preferably between 5% and 15%, most preferably between 7% and 12% of the total TAG content.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:1 20:5). Preferably, the content of TAG (18:1 18:1 20:5) is between 1.5% and 15%, more preferably between 2% and 10%, most preferably between 4% and 7.6% of the total TAG content.

As set forth above, the oil or lipid preferably comprises TAG (18:2 18:2 20:5). Preferably, the content of TAG (18:2 18:2 20:5) is between 3% and 20%, more preferably between 3% and 15%, most preferably between 3.5% and 9% of the total TAG content.

Also preferably, the sum of the contents of TAG (18:1 18:2 20:5), TAG (18:1 18:1 20:5), and TAG (18:2 18:2 20:5), i.e. the combined contents of these three TAG species, is between 5% and 55%, more preferably between 10% and 45%, most preferably between 20% and 26% of the total TAG content.

Thus, the most abundant TAG species are those that contain esterified EPA. EPA is better than DHA for some health reasons.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:2 22:6). Preferably, the content of TAG (18:1 18:2 22:6) is between 0.1% and 15%, more preferably between 0.1% and 10%, most preferably between 0.5% and 3% of the total TAG content.

As set forth above, the oil or lipid preferably comprises TAG (18:2 18:2 22:6). Preferably, the content of TAG (18:2 18:2 22:6) is between 0.1% and 15%, more preferably between 0.1% and 10%, most preferably between 0.5% and 2% of the total TAG content.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:1 22:6). Preferably, the content of TAG (18:1 18:1 22:6) is between 0.1% and 15%, more preferably between 0.1% and 10%, most preferably between 0.3% and 1% of the total TAG content.

Also preferably, the sum of the contents of TAG (18:1 18:2 22:6), TAG (18:2 18:2 22:6) and TAG (18:1 18:1 22:6), i.e. the combined content of these three TAG species, is between 0.3% and 45%, more preferably between 1% and 30%, most preferably between 1% and 5% of the total TAG content.

The oil or lipid of the present invention may also comprise TAG (18:3 18:3 20:5) and/or TAG (18:3 18:3 22:6). As can be seen from the examples, a low abundance of these TAG species was observed (see table 192). The low abundance can have an oxidative stability benefit.

Preferably, the content of TAG (18:3 18:3 20:5) is between 0.1% and 2%, more preferably between 0.1% and 1%, most preferably between 0.1% and 0.5% of the total TAG content.

Preferably, the content of TAG (18:3 18:3 22:6) is between 0.03% and 2%, more preferably between 0.03% and 1%, most preferably between 0.03% and 0.5% of the total TAG content. Further, it is contemplated that the content of TAG (18:3 18:3 22:6) is between 0.03% and 0.2% of the total TAG content.

As set forth above, the most abundant TAG species in wild-type Kumily plants were TAG (18:1 18:1 18:3), TAG (18:1 18:2 18:3), TAG (18:1 18:1 18:2), TAG (18:1 18:1 18:1), and (TAG 18:1 18:2 18:2). As compared to wild-type oil, the content of these species in seed oil from transgenic Brassice plants was advantageously reduced. One of these species, TAG (18:1 18:1 18:3), was not detectable in the oil.

Thus, the oil or lipid of the present invention may further one or more of the following features:

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:1 18:3). Preferably, the content of TAG (18:1 18:1 18:3) is between 0% and 10%, more preferably between 0% and 5%, most preferably between 0% and 3% of the total TAG content.

Also preferably, the content of TAG (18:1 18:1 18:3) of the total TAG content may be lower than 3%, in particular lower than 1%.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:2 18:3). Preferably, the content of TAG (18:1 18:2 18:3) is between 3% and 19%, more preferably between 4% and 18%, most preferably between 4% and 7% of the total TAG content.

Also preferably, the content of TAG (18:1 18:2 18:3) of the total TAG content may be lower than 7%.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:1 18:2). Preferably, the content of TAG (18:1 18:1 18:2) is between 1% and 10%, more preferably between 2% and 10%, most preferably between 2% and 5% of the total TAG content.

Also preferably, the content of TAG (18:1 18:1 18:2) of the total TAG content may be lower than 5%.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:1 18:1). Preferably, the content of TAG (18:1 18:1 18:1) is between 0.1% and 8%, more preferably between 0.5% and 5%, most preferably between 1% and 3% of the total TAG content.

Also preferably, the content of TAG (18:1 18:1 18:1) of the total TAG content may be lower than 3%.

As set forth above, the oil or lipid preferably comprises TAG (18:1 18:2 18:2). Preferably, the content of TAG (18:1 18:2 18:2) is between 0.1% and 13%, more preferably between 3% and 11%, most preferably between 4% and 10% of the total TAG content.

Also preferably, the content of TAG (18:1 18:2 18:2) of the total TAG content may be lower than 10%.

Also preferably, the total content and thus sum of the contents of TAG (18:1 18:1 18:3), TAG (18:1 18:2 18:3), TAG (18:1 18:1 18:2), and TAG (18:1 18:1 18:1), TAG (18:1 18:2 18:2) is between 5% and 50%, more preferably between 10% and 30%, most preferably between 14% and 22% of the total TAG content. In an embodiment, the total content of the aforementioned TAG species of the total TAG content is lower that 21.2% of the total TAG content.

As can be derived from Example 32, EPA and DHA are found most frequently esterified to TAG together with 18:1 and/or 18:2. These combinations of fatty acids are advantageous because they are more oxidatively stable than TAG species with more than one PUFA. In a preferred embodiment of the oil or lipid of the present invention, less that 21% of the total TAG species comprised by the oil or lipid contain more than one EPA, DPA, and DHA n-3 residue.

The oil or lipid of the present invention comprises TAGs (triacylglycerides), DAGs (diacylglycerides), and DAGs (diacylglycerides). As set forth certain TAG (triacylglyceride) species were decreased and certain TAG species were increased in the seeds of the plants of the present invention (in particular in seed oil of plants of the present invention). In addition, certain MAG and DAG species were decreased and certain MAG and DAG species were increased in the seeds of the plants of the present invention (in particular in seed oil of plants of the present invention).

E.g., the examples show that there is more esterified EPA and DHA in DAG than in MAG. Thus, is is envisaged that the content of esterified EPA and DHA in DAG (with respect to the total

esterfied fatty acid content in DAG) is larger than the content of esterified EPA and DHA in MAG (with respect to the total esterfied fatty acid content in MAG). Preferably, the ratio of the content of esterified EPA and DHA in DAG (with respect to the total esterfied fatty acid content in DAG) to the the content of esterified EPA and DHA in MAG (with respect to the total esterfied fatty acid content in MAG) is about 1.5.
Further, the Examples show that DHA is accumulated in the phosphatidylcholine (PC) fraction. This is thought to be achieved by expression of both a phospholipid and CoA dependent d4Des. It could be advantageous because DHA in phospholipids is thought to be more readily digestible.

Preferably, the content of DHA in in the phosphatidylcholine (PC) fraction in the oil or lipid of the present invention is between 2 and 12%, more preferably, between 2 and 10, most preferably between 5 and 9% of to the total fatty acid content of the PC fraction (preferably % w/w).

Morever, it is envisaged that the ratio of the content DHA in the PC fraction to the content in the TAG fraction of the oil or lipid of the present invention is larger than 1.

In addition, the studies underlying the present invention showed that the ratio of DHA to DPA n-3 is higher in the PC and PE (phosphatidylethanolamine) fraction than in the neutral lipid fraction (MAG, DAG, and TAG), see Example 30. This makes the PC and PE fractions potentially more valuable. In an embodiment of the oil or lipid of the present invention, the ratio of the content of DHA of all fatty acids in the PC and PE fraction to the content of DPA n-3 of all fatty acids in the PC and PE fraction is larger than the ratio of the content of DHA of all fatty acids in the MAG, DAG, and/or TAG fraction to the content of DPA n-3 of all fatty acids in the MAG, DAG, and/or TAG fraction.

Further, it is envisaged that the amount of DHA in the phospholipid fraction in the oil or lipid of the present is larger that the amount of EPA in the phospholipid fraction. In contrast, the amount of EPA in the TAG fraction in the oil or lipid of the present shall be larger that the amount of DHA in the TAG fraction. “Amount” is this paragraph preferably means absolute amount.

Example 31 shows that the abundant PC (phosphatidylcholine) species containing EPA or DHA are PC (18:2, 22:6) and PC (18:2 20:5). This majority of PUFA are combined with 18:2 which is more stable than if they are combined with 18:3 or another PUFA.

Thus, the oil or lipid of the present invention preferably comprises PC (18:2, 22:6), PC (18:2 20:5), or both. Preferred contents of the species in the oil or lipid of the present invention are given below. The content (levels) of the species are expressed as percentage (weight of a particular PC species) of the total weight of total PCs (i.e. all PCs) present in the oil or lipid). The contents are thus, preferably, given as weight percentage (% (w/w)). Accordingly, “%” preferably means “% (w/w) for a PC (or combination of PCs) compared to the total weight of PCs”.

Preferably, the content of PC (18:2 20:5) is between 2.5% and 15%, more preferably between 2.5% and 12%, most preferably between 3% and 10% of the total phosphatidylcholine content. Also preferably the content of this species is at least 3%.

Preferably, the content of PC (18:2, 22:6) is between 0.5% and 10%, more preferably between 1% and 7 %, most preferably between 1% and 6% of the total phosphatidylcholine content. Also preferably, the content of this species is at least 1.4%.

The present invention also relates to a plant comprising seeds comprising an oil of the present invention. Furthermore, the present invention relates to a seed comprising the oil of the present invention. Preferred plant species are described herein above. Preferably, the plant and the seed(s) comprises one ore more polynucleotides, expression cassettes, T-DNAs and/or construct as set forth in the context of the present invention.

The present invention also relates to a seed, in particular to bulked seeds, of the plant of the present invention. The seed/seeds shall contain the oil or lipid of the present invention.

In addition, as shown in the Examples, bulked seeds from event LBFGKN were determined to have 25.7 mg EPA+DHA/g seed and bulked seeds from event LBFDAU was determined to have 47.4 mg EPA+DHA/g seed. Thus, the present invention relates to seeds, in particular Brassica seeds, wherein 1 g of the seeds comprises a combined content of EPA and DHA of at least 10 mg, in particular of at least 20 mg. Further, it is envisaged that 1 g of the seeds of the present invention comprise a combined content of EPA and DHA of preferably 15 to 75 mg, more preferably of 20 to 60 mg, and most preferably of 25 to 50 mg.

Preferably, the seeds of the present invention comprise at least one T-DNA of the present invention. Thus, it is envisaged that said seeds are transgenic.

The present invention also concerns seed meal and seed cake produced from the seeds of the present invention, in particular from bulked seeds of the present invention.

Interestingly, the seeds that were produced in the context of the studies underlying the present invention had higher yield and larger contents of seed oil than expected (see e.g. Example 18, EPA/DHA in tables 152 and 153, and oil in table 154). The degree of unsaturation and elongation was increased in transgenic seed oil relative to controls. To achieve these increases the introduced desaturases and elongases consume additional ATP and NADH compared to controls. Therefore, the desaturases and elongases that we introduced are in direct competition with *de novo* fatty acid and oil synthesis, which also require ATP and NADH (every elongation requires two NADH and one ATP, and every desaturation requires one NADH). Moreover, the provision of malonyl-CoA for elongating fatty acids results in the loss of carbon in form of CO_2 (see Schwender et al 2004 Nature 432: 779-782). Therefore, we expected lower yield or oil content due to increased consumption of NADH, ATP, and increased loss of CO_2. However, we produced seeds containing high amounts of EPA and DHA that did not have differences in yield or in oil content relative to controls (see Example 18 and Table 154). For example, seed were produced containing EPA/DHA and more than 38.2% oil. This was not expected because a negative correlation between oil and PUFA content was observed (see Examples). Thus, the seeds of the present invention and the seeds of the plant or plants of the present invention, preferably, have a seed oil content at least 38%, More preferably, the seeds have a seed oil content of 38 to 42%, in particular of 38% to 40%. Preferably, seed oil content is expressed as percentage of oil weight of the total weight of seeds. Also preferably, the seed oil is produced in plants that have a seed yield that is no different from control plants when cultivated in the field.

The plant of the present invention, is preferably a transgenic B. napus plant. As described elsewhere herein, the plant shall produce both EPA and DHA. It is envisaged that the oil from the bulked seed contains more than 12% non-naturally occurring PUFA. Thus, the content of the non-naturally occurring fatty acids shall be more than 12% of the total fatty acid content. In another embodiment, the oil from the bulked seed contains more than 16% non-naturally occurring PUFA. In another embodiment, the oil from the bulked seed contains more than 18% non-naturally occurring PUFA. The expression “non-naturally occurring” preferably refers to PUFAs which do not occur naturally in wild-type Brassica plant. Preferably, said non-naturally occurring PUFASs are 18:2n-9, GLA, SDA, 20:2n-9, 20:3n-9, 20:3 n-6, 20:4n-6, 22:2n-6, 22:5n-6, 22:4n-3, 22:5n-3, and 22:6n-3. Although these PUFAs do not naturally occur in Brassica plants, they may nevertheless occurring in other non-transgenic organisms.

In an embodiment of the plant of the present invention, each T-DNA copy of the transgenic plant is stable over multiple generations as determined by copy number analysis at three or more locations on the T-DNA. In an embodiment of the plant of the present invention, the transgenic construct inserted into the B. napus plant has a copy number of 1 or 2. Thus, one or two copies of the T-DNA of the invention shall be present in the plant. In a preferred embodiment of the plant of the present invention, the transgenic construct inserted into the B. napus plant has a copy number of 1. Preferably, all inserted transgenes are fully functional (thus, the enzymes encoded by the genes shall retain their function). Preferably, the genetic insertion is located >5000 base pairs away from any endogenous gene. In an embodiment, the distance is measured from the end of the left and right border.

Preferably, the plant of the present invention, in particular the plant described is used in a method using produce an oil containing EPA and DHA. The oil has been described in detail elsewhere herein. In an embodiment, the oil comprises non-naturally occurring PUFA as described above.

The method of producing the oil may comprise the steps of growing a plant of the present invention such as to obtain oil-containing seeds thereof, harvesting said seed, and extracting oil form said seeds.

The present invention further envisages an oil containing EPA and DHA produced by plants the plant described above.

A further embodiment according to the invention is the use of the oil, lipid, fatty acids and/or the fatty acid composition in feedstuffs, foodstuffs, dietary supplies, cosmetics or pharmaceutical compositions as set forth in detail below. The oils, lipids, fatty acids or fatty acid mixtures according to the invention can be used for mixing with other oils, lipids, fatty acids or fatty acid mixtures of animal origin such as, for example, fish oils.
The present invention thus envisages feedstuffs, foodstuffs and dietary supplies. In an embodiment, the feedstuffs, foodstuffs and dietary supplies comprise the plant of the present invention, a part of a plant of the present invention, in particular a seed or seed, and/or the oil or lipid of the present invention.

In an embodiment, the feedstuffs, foodstuffs and dietary supplies comprise seedcake or seedmeal produced from the plant of the present invention, in particular from seeds of the plant of the present invention. Thus, the present invention also concerns seedcake or seedmeal produced from the plant of the present invention, in particular from seeds of the plant of the present invention. In an embodiment, the seedmeal or seedcake comprises at least one T-DNA of the present invention.

The feedstuffs, foodstuffs and dietary supplies may comprise a fatty acid ester, or a fatty acid produced from a plant of the present invention (or from a part thereof, in particular from the seeds).

The feedstuff of the present invention can be used in aquaculture. Using the feedstuff will allow to increase the contents of VLC-PUFAs in fish. In an embodiment, the fish is salmon.

The term "composition" refers to any composition formulated in solid, liquid or gaseous form. Said composition comprises the compound of the invention optionally together with suitable auxiliary compounds such as diluents or carriers or further ingredients. In this context, it is distinguished for the present invention between auxiliary compounds, i.e. compounds which do not contribute to the effects elicited by the compounds of the present invention upon application of the composition for its desired purpose, and further ingredients, i.e. compounds which contribute a further effect or modulate the effect of the compounds of the present invention. Suitable diluents and/or carriers depend on the purpose for which the composition is to be used and the other ingredients. The person skilled in the art can determine such suitable diluents and/or carriers without further ado. Examples of suitable carriers and/or diluents are well known in the art and include saline solutions such as buffers, water, emulsions, such as oil/water emulsions, various types of wetting agents, etc.

In a more preferred embodiment of the oil-, fatty acid or lipid-containing composition, the said composition is further formulated as a pharmaceutical composition, a cosmetic composition, a foodstuff, a feedstuff, preferably, fish feed or a dietary supply.

The term "pharmaceutical composition" as used herein comprises the compounds of the present invention and optionally one or more pharmaceutically acceptable carrier. The compounds of the present invention can be formulated as pharmaceutically acceptable salts. Acceptable salts comprise acetate, methylester, Hel, sulfate, chloride and the like. The pharmaceutical compositions are, preferably, administered topically or systemically. Suitable routes of administration conventionally used for drug administration are oral, intravenous, or parenteral administration as well as inhalation. However, depending on the nature and mode of action of a compound, the pharmaceutical compositions may be administered by other routes as well. For example, polynucleotide compounds may be administered in a gene therapy approach by using viral vectors or viruses or liposomes.

Moreover, the compounds can be administered in combination with other drugs either in a common pharmaceutical composition or as separated pharmaceutical compositions wherein said separated pharmaceutical compositions may be provided in form of a kit of parts. The compounds are, preferably, administered in conventional dosage forms prepared by combining the drugs with standard pharmaceutical carriers according to conventional procedures. These procedures may involve mixing, granulating and compressing or dissolving the ingredients as appropriate to the desired preparation. It will be appreciated that the form and character of the pharmaceutically acceptable carrier or diluent is dictated by the amount of active ingredient with which it is to be combined, the route of administration and other well-known variables. The carrier(s) must be acceptable in the sense of being compatible with the other ingredients of the formulation and being not deleterious to the recipient thereof. The pharmaceutical carrier employed may be, for example, a solid, a gel or a liquid. Exemplary of solid carriers are lactose, terra alba, sucrose, talc, gelatin, agar, pectin, acacia, magnesium stearate, stearic acid and the like. Exemplary of liquid carriers are phosphate buffered saline solution, syrup, oil such as peanut oil and olive oil, water, emulsions, various types of wetting agents, sterile solutions and the like. Similarly, the carrier or diluent may include time delay material well known to the art, such as glyceryl mono-stearate or glyceryl distearate alone or with a wax. Said suitable carriers comprise those mentioned above and others well known in the art, see, e.g., Remington's Pharmaceutical Sciences, Mack Publishing Company, Easton, Pennsylvania. The diluent(s) is/are selected so as not to affect the biological activity of the combination. Examples of such diluents are distilled water, physiological saline, Ringer's solutions, dextrose solution, and Hank's solution. In addition, the pharmaceutical composition or formulation may also include other carriers, adjuvants, or nontoxic, nontherapeutic, nonimmunogenic stabilizers and the like. A therapeutically effective dose refers to an amount of the compounds to be used in a pharmaceutical composition of the present invention which prevents, ameliorates or treats the symptoms accompanying a disease or condition referred to in this specification. Therapeutic efficacy and toxicity of such compounds can be determined by standard pharmaceutical procedures in cell cultures or experimental animals, e.g., ED50 (the dose therapeutically effective in 50% of the population) and LD50 (the dose lethal to 50% of the population). The dose ratio between therapeutic and toxic effects is the therapeutic index, and it can be expressed as the ratio, LD50/ED50. The dosage regimen will be determined by the attending physician and other clinical factors; preferably in accordance with anyone of the above described methods. As is well known in the medical arts, dosages for anyone patient depends upon many factors, including the patient's size, body surface area, age, the particular compound to be administered, sex, time and route of administration, general health, and other drugs being administered concurrently. Progress can be monitored by periodic assessment. A typical dose can be, for example, in the range of 1 to 1000 µg; however, doses below or above this exemplary range are envisioned, especially considering the aforementioned factors. However, depending on the subject and the mode of administration, the quantity of substance administration may vary over a wide range. The pharmaceutical compositions and formulations referred to herein are administered at least once in order to treat or ameliorate or prevent a disease or condition recited in this specification. However, the said pharmaceutical compositions may be administered more than one time, for example from one to four times daily up to a non-limited number of days. Specific pharmaceutical compositions are prepared in a manner well known in the pharmaceutical art and comprise at least one active compound referred to herein above in admixture or otherwise associated with a pharmaceutically acceptable carrier or diluent. For making those specific pharmaceutical compositions, the active compound(s) will usually be mixed with a carrier or the diluent, or enclosed or encapsulated in a capsule, sachet, cachet, paper or other suitable containers or vehicles. The resulting formulations are to be adopted to the mode of administration, i.e. in the forms of tablets, capsules, suppositories, solutions, suspensions or the like. Dosage recommendations shall be indicated in the prescribers or users instructions in order to anticipate dose adjustments depending on the considered recipient.

The term "cosmetic composition" relates to a composition which can be formulated as described for a pharmaceutical composition above. For a cosmetic composition, likewise, it is envisaged that the compounds of the present invention are also, preferably, used in substantially pure form. Impurities, however, may be less critical than for a pharmaceutical composition. Cosmetic compositions are, preferably, to be applied topically.

Preferred cosmetic compositions comprising the compounds of the present invention can be formulated as a hair tonic, a hair restorer composition, a shampoo, a powder, a jelly, a hair rinse, an ointment, a hair lotion, a paste, a hair cream, a hair spray and/or a hair aerosol.
Seeds of three events described in detail in the examples section below have been deposited at ATCC under the provisions of the Budapest treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure, i.e. seeds of event “LBFLFK” = ATCC Designation “PTA-121703”, seeds of event “LBFDHG” = ATCC designation “PTA-121704”, and seeds of event “LBFDAU” = ATCC Designation “PTA-122340”. Applicants have no authority to waive any restrictions imposed by law on the transfer of biological material or its transportation in commerce. Applicants do not waive any infringement of their rights granted under this patent or rights applicable to the deposited events under the Plant Variety Protection Act (7 USC sec. 2321, et seq.), Unauthorized seed multiplication prohibited. This seed may be regulated according to national law. The deposition of seeds was made only for convenience of the person skilled in the art and does not constitute or imply any confession, admission, declaration or assertion that deposited seed are required to fully describe the invention, to fully enable the invention or for carrying out the invention or any part or aspect thereof. Also, the deposition of seeds does not constitute or imply any recommendation to limit the application of any method of the present invention to the application of such seed or any material comprised in such seed, e.g. nucleic acids, proteins or any fragment of such nucleic acid or protein.

The deposited seeds are derived from plants that were transformed with the T-DNA vector having a sequence as shown in SEQ ID NO: 3.
The events LBFLFK and LBFDAU are described herein in more detail. In an embodiment, the plant of the present invention comprises the T-DNAs comprised by LBFLFK and LBFDAU, preferably at the the position in the genome (as in the plants designated LBFLFK and LBFDAU.

In one embodiment, the present invention thus provides Brassica plants comprising transgenic Brassica event LBFLFK deposited as ATCC Designation “PTA-121703”. Brassica event LBFLFK contains two insertions of T-DNA of the binary T-plasmid VC-LTM593-1qcz rc, the insertions being designated LBFLFK Locus 1 and LBFLFK Locus 2. The Brassica plants of this embodiment include progeny that are indistinguishable from Brassica event LBFLFK (to the extent that such progeny also contain at least one allele corresponding to LBKLFK Locus 1 and/or LBFLFK Locus 2). The Brassica plants of this embodiment comprise unique genomic DNA/transgene junction points, and consequently unique junction regions, for each LBFLFK insertion: the junction region for LBFLFK Locus 1 having at least the polynucleotide sequence of SEQ ID NO:282 or at least the polynucleotide sequence of SEQ ID NO:283, and the junction region for LBFLFK Locus 2 having at least the polynucleotide sequence of SEQ ID NO:291 or at least the polynucleotide sequence of SEQ ID NO:292. Also included in this embodiment are seeds, plant parts, plant cells, and plant products derived from Brassica event LBFLFK and progeny thereof. In another embodiment, the invention provides commodity products, including canola oil and meal, produced from Brassica event LBFLFK and/or its progeny.

In another embodiment, the invention provides Brassica plants comprising transgenic Brassica event LBFDAU deposited as ATCC Designation “PTA-122340”. Brassica event LBFDAU contains two insertions of the T-DNA of the binary T-plasmid VC-LTM593-1qcz rc, the insertions being designated LBFDAU Locus 1 and/or LBFDAU Locus 2. The Brassica plants of this embodiment include and progeny thereof that are indistinguishable from Brassica event LBFDAU (to the extent that such progeny also contain at least one allele that corresponds to the inserted transgenic DNA). The Brassica plants of this embodiment comprise unique genomic DNA/transgene junction points, and consequently two unique junction regions, for each LBFDAU insertion: the junction region for LBFDAU Locus 1 having at least the polynucleotide sequence of SEQ ID NO:300 or at least the polynucleotide sequence of SEQ ID NO:301 and the junction region for LBFDAU Locus 2 having at least the polynucleotide sequence of SEQ ID NO:309 or at least the polynucleotide sequence of SEQ ID NO:310. Also included in this embodiment are seeds, plant parts, plant cells, and plant products derived from Brassica event LBFDAU and progeny thereof. In another embodiment, the invention provides commodity products, including canola oil and meal, produced from Brassica event LBFDAU and/or its progeny.

The aforementioned plant of the present invention can be used in method the context of the present invention. E.g, the oil, fatty acid, or lipid of the present invention is obtainable from the plant (and can be extracted).

The plants of the invention have been modified by the transformation binary T-plasmid VC-LTM593-1qcz rc (SEQ ID NO:3) described in the Examples section. The T-DNA of this vector (which is a T-DNA of the present invention) comprises (preferably in the following order), polynucleotides encoding the following enzymes of the VLC-PUFA biosynthetic pathway: Delta-6 ELONGASE from Physcomitrella patens; Delta-5 DESATURASE from Thraustochytrium sp. ATCC21685; Delta-6 DESATURASE from Ostreococcus tauri; Delta-6 ELONGASE from Thalassiosira pseudonana; Delta-12 DESATURASE from Phythophthora sojae; Omega-3 DESATURASE from Pythium irregulare; Omega-3-DESATURASE from Phythophthora infestans; Delta-5 DESATURASE from Thraustochytrium sp. ATCC21685; Delta-4 DESATURASE from Thraustochytrium sp.; Omega-3 DESATURASE from Pythium irregulare; Delta-4 DESATURASE from Pavlova lutheri; Delta-5 ELONGASE from Ostreococcus tauri. Thus, the aforementioned T-DNA of the present invention comprises two copies of a polynucleotide encoding a Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685, and two copies of a polyncucleotide encoding Omega-3 desaturase from *Pythium irregulare.*

The T-DNA of VC-LTM593-1qcz (SEQ ID NO:3) further comprises a polynucleotide encoding the selectable marker acetohydroxy acid synthase, which confers tolerance to imidazolinone herbicides.

The invention further relates to the T-DNA insertions in each of Brassica events LBFLFK and LBFDAU, and to the genomic DNA/transgene insertions, i.e., the Locus 1 and Locus 2 junction regions found in Brassica plants or seeds comprising Brassica event LBFLFK, to the genomic DNA/transgene insertions, i.e., Locus 1 and Locus 2 junction regions found in Brassica plants or seeds comprising Brassica event LBFDAU, and the detection of the respective genomic DNA/transgene insertions, i.e., the respective Locus 1 and Locus 2 junction regions in Brassica plants or seed comprising event LBFLFK or event LBFDAU and progeny thereof.

Progeny, variants and mutants of the regenerated plants are also included within the scope of the invention, provided that the progeny, variants and mutants comprise a LBFLFK or LBFDAU event. Preferably, the progeny, variants, and mutants contain two insertions of T-DNA of the binary T-plasmid VC-LTM593-1qcz rc, the insertions being designated LBFLFK Locus 1 and LBFLFK Locus 2, provided that the progeny, variants and mutants comprise two insertions of the T-DNA of the binary T-plasmid VC-LTM593-1qcz rc, the insertions being designated LBFDAU Locus 1 and LBFDAU Locus 2.

A transgenic "event" is preferably produced by transformation of plant cells with a heterologous DNA construct(s) including a nucleic acid expression cassette that comprises one or more transgene(s) of interest, the regeneration of a population of plants from cells which each comprise the inserted transgene(s) and selection of a particular plant characterized by insertion into a particular genome location. An event is characterized phenotypically by the expression of the transgene(s). At the genetic level, an event is part of the genetic makeup of a plant. The term "event" refers to the original transformant and progeny of the transformant that include the heterologous DNA. The term "event" also refers to progeny, produced by a sexual outcross between the transformant and another variety, that include the heterologous DNA. Even after repeated back-crossing to a recurrent parent, the inserted DNA and flanking DNA from the transformed parent are present in the progeny of the cross at the same chromosomal location. The term "event" also refers to DNA from the original transformant comprising the inserted DNA and flanking sequence immediately adjacent to the inserted DNA that would be expected to be transferred to a progeny as the result of a sexual cross of one parental line that includes the inserted DNA (e.g., the original transformant and progeny resulting from selfing) and a parental line that does not contain the inserted DNA. In accordance with the invention, progeny of the Brassica LBFLFK event preferably comprises either LBFLFK Locus 1 or LBFLFK Locus 2, or both LBFLFK Locus 1 and LBFLFK Locus 2. Similarly, progeny of the Brassica LBFDAU event preferably comprises either LBFDAU Locus 1 or LBFDAU Locus 2, or both LBFDAU Locus 1 and LBFDAU Locus 2.

A "flanking region" or "flanking sequence" as used herein preferably refers to a sequence of at least 20, 50, 100, 200, 300, 400, 1000, 1500, 2000, 2500 or 5000 base pairs or greater which is located either immediately upstream of and contiguous with, or immediately downstream of and contiguous with, the original foreign insert DNA molecule. Non-limiting examples of the flanking regions of the LBFLFK event comprise, for Locus 1, nucleotides 1 to 570 of SEQ ID NO: 284, nucleotides 229 to 811 of SEQ ID NO:285 and for Locus 2, nucleotides 1 to 2468 of SEQ ID NO:293, and/or nucleotides 242 to 1800 of SEQ ID NO:294 and variants and fragments thereof. Non-limiting examples of the flanking regions of the LBFDAU event comprise, for Locus 1, nucleotides 1 to 1017 of SEQ ID NO: 302, nucleotides 637 to 1677 of SEQ ID NO:303, and for Locus 2, nucleotides 1 to 1099 of SEQ ID NO:311 and/or nucleotides 288 to 1321 of SEQ ID NO: 312 and variants and fragments thereof.

Non-limiting examples of junction DNA from the LBFLFK event comprise, for Locus 1, SEQ ID NO:282, SEQ ID NO:283, and for Locus 2, SEQ ID NO:291, and/or SEQ ID NO:292, complements thereof, or variants and fragments thereof. Non-limiting examples of junction DNA from the LBFDAU event comprise, for Locus 1, SEQ ID NO:300, SEQ ID NO:301, and for Locus 2, SEQ ID NO:309 and/or SEQ ID NO:310, complements thereof, or variants and fragments thereof.

The oil of the aforementioned plants of the present invention preferably is an oil as specified elsewhere herein.

In one embodiment, the transgenic Brassica plants of the invention comprise event LBFLFK (ATCC designation PTA-121703). Seed and progeny of event LBFLFK are also encompassed in this embodiment. In another embodiment, the transgenic Brassica plants of the invention comprise event LBFDAU (ATCC designation PTA-122340). Seed and progeny of event LBFDAU are also encompassed in this embodiment.

The Brassica plants LBFLFK and LBFDAU can be used to manufacture commodities typically acquired from Brassica. Seeds of LBFLFK and LBFDAU can be processed into meal or oil as well as be used as an oil source in animal feeds for both terrestrial and aquatic animals.

In accordance with the invention embodied in Brassica event LBFLFK, the LBFLFK Locus 1 genomic DNA/transgene junction region and/or the LBFLFK Locus 2 genomic DNA/transgene junction region is present in Brassica plant LBFLFK (ATCC Accession No. PTA-121703) and progeny thereof. The LBFLFK Locus 1 DNA/transgene right border junction region comprises SEQ ID NO:282 and the LBFLFK Locus 1 left border junction region comprises SEQ ID NO:283, and the LBFLFK Locus 2 right border junction region comprises SEQ ID NO:291 and the LBFLFK left border junction region comprises SEQ ID NO:292. DNA sequences are provided that comprise at least one junction region sequence of event LBFLFK selected from the group consisting of SEQ ID NO:282 corresponding to positions 561 through 580 of SEQ ID NO:280); SEQ ID NO:283 corresponding to positions 44318 through 44337 of SEQ ID NO:280); SEQ ID NO:291 corresponding to positions 2459 through 2478 of SEQ ID NO:289); and SEQ ID NO:292 corresponding to positions 46232 through 46251 of SEQ ID NO:289), and complements thereof; wherein detection of these sequences in a biological sample containing Brassica DNA is diagnostic for the presence of Brassica event LBFLFK DNA in said sample. A Brassica event LBFLFK and Brassica seed comprising these DNA molecules is an aspect of this invention.

For example, to determine whether the Brassica plant resulting from a sexual cross contains transgenic DNA from event LBFLFK, DNA extracted from a Brassica plant tissue sample may be subjected to nucleic acid amplification method using (i) a first primer pair that includes: (a) a first primer derived from an LBFLFK Locus 1 flanking sequence and (b) a second primer derived from the LBFLFK Locus 1 inserted heterologous DNA, wherein amplification of the first and second primers produces an amplicon that is diagnostic for the presence of event LBFLFK Locus 1 DNA; and (ii) a second primer pair that includes (a) a third primer derived from an LBFLFK Locus 2 flanking sequence and (b) a fourth primer derived from the LBFLFK Locus 2 inserted heterologous DNA, wherein amplification of the third and fourth primers produces an amplicon that is diagnostic for the presence of event LBFLFK Locus 2 DNA.

The primer DNA molecules specific for target sequences in Brassica event LBFLFK comprise at least 11 contiguous nucleotides of any portion of the insert DNAs, flanking regions, and/or junction regions of LBFLFK Locus 1 and Locus 2. For example, LBFLFK Locus 1 primer DNA molecules may be derived from any of SEQ ID NO:280, SEQ ID NO:281, SEQ ID NO:282, or SEQ ID NO:283; SEQ ID NO:284, or SEQ ID NO:285, or complements thereof, to detect LBFLFK Locus 1. Similarly, LBFLFK Locus 2 primer DNA molecules may be derived from any of SEQ ID NO:293, SEQ ID NO:294, SEQ ID NO:291, or SEQ ID NO:292; SEQ ID NO:290, or SEQ ID NO:289, or complements thereof, to detect LBFLFK Locus 2. Those of skill in the art may use these primers to design primer pairs to produce LBFLFK Locus 1 and Locus 2 amplicons using known DNA amplification methods. The LBFLFK Locus 1 and Locus 2 amplicons produced using these DNA primers in the DNA amplification method are diagnostic for Brassica event LBFLFK when the amplification product contains an amplicon comprising an LBFLFK Locus 1 junction region SEQ ID NO:282 or SEQ ID NO:283, or complements thereof, and an amplicon comprising an LBFLFK Locus 2 junction region SEQ ID NO:291, or SEQ ID NO:292, or complements thereof.

In accordance with the invention embodied in Brassica event LBFDAU, the LBFDAU Locus 1 genomic DNA/transgene junction region and/or the LBFDAU Locus 2 genomic DNA/transgene junction region is present in Brassica event LBFDAU (ATCC Accession No. PTA-122340) and progeny thereof. The LBFDAU Locus 1 DNA/transgene right border junction region comprises SEQ ID NO:300 and the LBFDAU Locus 1 left border junction region comprises SEQ ID NO:301, and the LBFDAU Locus 2 right border junction region comprises SEQ ID NO:309 and the LBFDAU left border junction region comprises SEQ ID NO:310. DNA sequences are provided that comprise at least one junction region sequence of event LBFDAU selected from the group consisting of SEQ ID NO:300 (corresponding to positions 1008 through 1027 of SEQ ID NO:298, as shown in FIG. 4); SEQ ID NO:301 (corresponding to positions 44728 through 44747 of SEQ ID NO:298, as shown in FIG. 4); SEQ ID NO:309 (corresponding to positions 1090 through 1109 of SEQ ID NO:307, as shown in FIG. 5); and SEQ ID NO:310 (corresponding to positions 38577 through 38596 of SEQ ID NO:307, as shown in FIG. 5) and complements thereof; wherein detection of these sequences in a biological sample containing Brassica DNA is diagnostic for the presence of Brassica event LBFDAU DNA in said sample. A Brassica event LBFDAU and Brassica seed comprising these DNA molecules is an aspect of this invention.

For example, to determine whether the Brassica plant resulting from a sexual cross contains transgenic DNA from event LBFDAU, DNA extracted from a Brassica plant tissue sample may be subjected to nucleic acid amplification method using (i) a first primer pair that includes: (a) a first primer derived from an LBFDAU Locus 1 flanking sequence and (b) a second primer derived from the LBFDAU Locus 1 inserted heterologous DNA, wherein amplification of the first and second primers produces an amplicon that is diagnostic for the presence of event LBFDAU Locus 1 DNA; and/or (ii) a second primer pair that includes (a) a third primer derived from an LBFDAU Locus 2 flanking sequence and (b) a fourth primer derived from the LBFDAU Locus 2 inserted heterologous DNA, wherein amplification of the third and fourth primers produces an amplicon that is diagnostic for the presence of event LBFDAU Locus 2 DNA.

Seed derived from Brassica event LBFLFK or Brassica event LBFDAU for sale for planting or for making commodity products is an aspect of the invention. Such commodity products include canola oil or meal containing VLC-PUFAs including but not limited to EPA and DHA. Commodity products derived from Brassica event LBFLFK comprise a detectable amount a DNA molecule comprising SEQ ID NO:282, SEQ ID NO:283, SEQ ID NO:291, and/or SEQ ID NO:292. Commodity products derived from Brassica event LBFDAU comprise a detectable amount a DNA molecule comprising SEQ ID NO:300, SEQ ID NO:301, SEQ ID NO:309, and/or SEQ ID NO:310. Exemplary commodity products derived from events LBFLFK and LBFDAU include, but are not limited to, cooking oil, salad oil, shortening, nutritionally enhanced foods, animal feed, pharmaceutical compositions, cosmetic compositions, hair care products, and the like.

The invention also provides a commercially relevant source of plant material, preferably of seed. As such, the invention provides a heap of at least 5kg, preferably of at least 10 kg, more preferably of at least 50kg, even more preferably of at least 100 kg, even more preferably of at least 500 kg, even more preferably of at least 1t, even more preferably of at least 2t, even more preferably of at least 5t of plant material, wherein the plant material comprises VLC-PUFAs as described according to the invention. As described herein, it is a merit of the present invention to provide, for the first time, an agronomically reliable source of VLC-PUFA plant oil, and to this end such heap of plant material is provided. The plant material is preferably plant seed, even more preferably seed of VLC-PUFA producing seed, such that the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 10% (w/w) and/or the content of DHA is at least 1% (w/w) of the total seed fatty acid content at an oil content of 30% (w/w), or meal of such plant seed. Also, the invention provides a container comprising such plant seed in an amount of at least 5kg, preferably of at least 10 kg, more preferably of at least 50kg, even more preferably of at least 100 kg, even more preferably of at least 500 kg, even more preferably of at least 1t, even more preferably of at least 2t, even more preferably of at least 5t. The invention thus demonstrates that the invention has well eclipsed anecdotal findings of lab scale VLC-PUFA containing plants, and instead has overcome the additional requirements for providing, on a large scale, a reliable source for VLC-PUFA and particularly for EPA and/or DHA in plant oil and plant material.

The present invention allows for the generation of plants comprising a modified fatty acid composition (as compared to control plants). Thus, the T-DNAs, the expression cassettes, vectors, polynucleotides (in particular the combination of polynucleotides), and polypeptides ((in particular the combination of polynucleotides) as disclosed herein can be used for modifying the fatty acid composition of a plant. In an embodiment, the content of at least one fatty acid disclosed in Table 18 or 181 is modified in seed oil (increased or decreased as compared to the content in seed oil of a control plant). In another embodiment, the content of at least one fatty acid disclosed in Table 18 or 181 is modified in in the monoacylgylcerol (MAG) fraction, the diacylgylcerol (DAG) fraction, the triacylgylcerol (TAG) fraction, phosphatidylcholine (PC) fraction and/or phosphatidylethanolamine (PE) fraction of seed oil (increased or decreased as compared to the content of seed oil of a control plant). In another embodiment, the content of at least one Lysophosphatidylcholine species shown in Table 189 is modified in seed oil (increased or decreased as compared to the content in seed oil of a control plant). In another embodiment, the content of at least one Phosphatidylethanolamine species shown in Table 190 is modified in seed oil (increased or decreased as compared to the content in seed oil of a control plant). In another embodiment, the content of at least one Lysophosphatidylethanolamine species shown in Table 191 is modified in seed oil (increased or decreased as compared to the content in seed oil of a control plant). In another embodiment, the content of at least one Triacylglycerol species shown in Table 192 is modified in seed oil (increased or decreased as compared to the content in seed oil of a control plant).

The definitions and explanations given herein above, preferably, apply mutatis mutandis to the following (e.g. with respect to the “plant”, “the control plant” etc.).

It has been shown in the context of the studies underlying that the present invention that that the generated plants produce mead acid (20:3n-9, see Example 29). The mead acid may be made

from the side activities of d6Des, d6Elo, and d5Des, using 18:1n-9 to make 18:2n-9 (by d6Des), then 20:2n-9 (by d6Elo), then 20:3n-9 (by d5Des). Interestingly, in mead acid in fungi is only made if the d12Des is mutated to be inactive (Takeno *et al.* 2005 App. Environ. Microbiol. 71(9): 5124-5128). However, the studies underlying the present invention surprisingly show that mead acid is produced in plants even when a d12Des is overexpressed.
Accordingly, the present invention relates to a method for increasing the content of Mead acid (20:3n-9) in a plant relative to a control plant, comprising expressing in a plant at least one polynucleotide encoding a delta-6-desaturase, at least one polynucleotide encoding a delta-6-elongase, and at least one polynucleotide encoding a delta-5-desaturase.
In addition, the present invention relates to a method for producing Mead acid (20:3n-9) in a plant relative to a control plant, comprising expressing in a plant, at least one polynucleotide encoding a delta-6-desaturase, at least one polynucleotide encoding a delta-6-elongase, and at least one polynucleotide encoding a delta-5-desaturase.

The aforementioned methods may further comprise the expression of further desatuarase or eleogase, in particular of one or more of a delta-12-desaturase, omega-3-desaturase, a delta-5-elongase, and delta-4-desaturase. Thus, at least one, two, three, or in particular four further enzymatic actitivities can be expressed in the plant.

In an embodiment, the methods further comprise expressing in the plant at least one polynucleotide encoding a delta-12-desaturase.

In an embodiment, the methods further comprise expressing in the plant at least one polynucleotide encoding an omega-3-desaturase.

In an embodiment, the methods further comprise expressing in the plant at least one polynucleotide encoding a delta-5-elongase.

In an embodiment, the methods further comprise expressing in the plant at least one polynucleotide encoding a delta-4-desaturase. In an embodiment, at least one CoA dependent delta-4-desaturase and at least one phospholipid dependent delta-4 desaturase is expressed.

In a particular preferred embodiment, the methods further comprise expressing in the plant at least one polynucleotide encoding a delta-12-desaturase, at least one polynucleotide encoding an omega-3-desaturase, at least one polynucleotide encoding a delta-5-elongase, and at least one polynucleotide encoding delta-4-desaturase.

Preferred polynucleotides encoding desaturases and elongases are described above.

The gene dosage effect described above may be also used for the the producing of mead acid or for increasing the content of mead acid in plants.

Thus, it is contemplated to express at least one polynucleotide encoding a delta-6-desaturase, at least two polynucleotides encoding a delta-6-elongase, and at least two polynucleotides encoding a delta-5-desaturase. Moreover, at least one polynucleotide encoding a delta-12-desaturase, at least three polynucleotides encoding an omega-3-desaturase, at least one polynucleotide encoding a delta-5-elongase, and/or at least two polynucleotides encoding a delta-4-desaturase can be further expressed (preferably at least one CoA dependent delta-4-desaturase and at least one phospholipid dependent delta-4 desaturase).

In an embodiment, at least one polynucleotide encoding a delta-6 elongase from Physcomitrella patens, at least one polynucleotide encoding a delta-6 elongase from Thalassiosira pseudonana, and at least two polynucleotides encoding a delta-5 desaturase from Thraustochytrium sp are expressed. Moreover, at least one polynucleotide encoding a omega-3-desaturase from Phythophthora infestans, at least two polynucleotides encoding a omega-3 desaturase from Pythium irregulare, at least one polynucleotide encoding a delta-5 elongase from Ostreococcus tauri, and at least one polynucleotide encoding a delta-4 desaturase from Thraustochytrium sp., and/or at least one polynucleotide encoding a delta-4 desaturase from Pavlova lutheri can be expressed.

Preferably, the polynucleotides to be expressed are recombinant polynucleotides. More preferably, the polynucleotides are present on one T-DNA which is comprised by the genome of the plant. Thus, the T-DNA is stably integrated into the genome. Preferably, the polynucleotides encoding for the desaturaes and elongases as set forth herein are comprised by the same T-DNA.

Preferably, the polynucleotides encoding the desaturases or elongases (i.e. each of the polynucleotides) are operably linked to an expression control sequence (see elsewhere herein for a definition). Moreover, the polynucleotides may be linked to a terminator, thereby forming an expression cassette comprising an expression control sequence, the target gene, and the terminator.

In a particular preferred embodiment, the polynucleotides are expressed in the seeds of the plant. Accordingly, the expression control sequences may be seed-specific promoters. Preferred seed-specific promoters are e.g. disclosed in Table 11 in the Examples section.

In an embodiment, the polynucleotides are expressed by introducing and expressing the polynucleotides in the plants. How to introduce polynucleotides into a plant is well known in the art. Preferred methods are described elsewhere herein. In an embodiment, the polynucleotides are introduced into a plant by Agrobacterium-mediated transformation.

In an embodiment, the mead acid content is increased in the seeds as compared to the mead acid in seeds of a control plant. Preferably, the mead acid content in seed oil is increased in the seeds is increased as compared to the mead acid in seed oil of a control plant.

Preferred plants are described above. In an embodiment, the plant is an oilseed plant. Preferably, the plant is selected from the group consisting of flax (Linum sp.), rapeseed (Brassica sp.), soybean (Glycine and Soja sp.), sunflower (Helianthus sp.), cotton (Gossypium sp.), corn (Zea mays), olive (Olea sp.), safflower (Carthamus sp.), cocoa (Theobroma cacoa), peanut (Arachis sp.), hemp, camelina, crambe, oil palm, coconuts, groundnuts, sesame seed, castor bean, lesquerella, tallow tree, sheanuts, tungnuts, kapok fruit, poppy seed, jojoba seeds and perilla. More preferably, the plant is a plant of the family Brassicaceae, preferably of genus Brassica and most preferably of a species comprising a genome of one or two members of the species Brassica oleracea, Brassica nigra and Brassica rapa, thus in particular of the species Brassica napus, Brassica carinata, Brassica juncea, Brassica oleracea, Brassica nigra or Brassica rapa.

In an embodiment, the method further comprises the step of a selecting for a plant having an increased mead acid content, in particular in seed oil. In embodiment, the selection is done based on the mead acid content. The step may thus comprise the step of determining the mead acid content in the seeds, or seed oil of the plant. How to determine the mead acid content is e.g. described in Example 29.

The Mead acid is preferably esterified mead acid.

Upon expression of the polynucleotides referred to above in the seeds of the plant, mead acid is produced. Thus, the plants expressing said polynucleotides, in particular the seeds of the plants shall comprise/produce mead acid. Preferably, the content of Mead acid (20:3n-9) in the seed oil of the plant is between about 0.1% and 2%, more preferably between about 0.1% and 1%, most preferably between about 0.1% and 0.5% of the total fatty acid content of seed oil (in particular the total content of esterified fatty acids). Further VLC-PUFAs may be present in the seed oil (as described elsewhere herein in connection with the oil of the present invention).

The present invention also relates to a construct or T-DNA comprising expression cassettes for the desaturases and elongases as referred to in the context of the method of increasing the content of mead acid. Thus, the present invention also relates to a construct comprising at least one expression cassette for for a delta-6-desaturase, at least one expression cassette for a delta-6-elongase, and at least one expression cassette for a delta-5-desaturase. The construct or T-DNA may further comprise at least one expression cassette for a delta-12-desaturase, at least one expression cassette for an omega-3-desaturase, at least one expression cassette for a delta-5-elongase, and/or at least one expression cassette for a delta-4-desaturase.

In an embodiment, the construct or T-DNA comprises at least one expression cassette for a delta-6 elongase from Physcomitrella patens, at least one expression cassette for a delta-6 elongase from Thalassiosira pseudonana, and at least two expression cassettes for a delta-5 desaturase from Thraustochytrium sp. (in particular Thraustochytrium sp. ATCC21685), and optionally at least two expression cassettes for an omega-3 desaturase from Pythium irregulare, at least one expression cassette for a omega-3-desaturase from Phythophthora infestans, at least one expression cassette for a delta-5 elongase from Ostreococcus tauri, and at least one expression cassette for a delta-4 desaturase from Thraustochytrium sp., and/or at least one expression cassette for a delta-4 desaturase from Pavlova lutheri.

The present invention further relates to the use of i) a construct or T-DNA of the present invention or of ii) at least one polynucleotide encoding a delta-6-desaturase, at least one polynucleotide encoding a delta-6-elongase, at least one polynucleotide encoding a delta-5-desaturase, for a) increasing the mead acid content of a plant (in particular in the seeds) relative to a control plants (in particular in the seeds of a control plant) or for producing mead acid in a plant, in particular in the seeds of a plant.

Preferably, also further polynucleotides encoding desaturases and/or elongases as referred to in the context of the method for increasing mead acid can be used (such as a polynucleotide encoding a delta-12-desaturase).

The present invention also relates to plant, or plant cells transformed with or comprising i) a construct or T-DNA of the present invention or ii) at least one polynucleotide encoding a delta-6-desaturase, at least one polynucleotide encoding a delta-6-elongase, at least one polynucleotide encoding a delta-5-desaturase. In an embodiment, the plant or plant cell further is transformed with or comprises the further polynucleotides encoding desaturases and/or elongases as referred to in the context of the method for increasing mead acid can be used (such as a polynucleotide encoding a delta-12-desaturase). Preferred polynucleotide sequences for the desaturases and elongases are disclosed above.

Further, the present invention relates to a method of mead acid production, comprising the steps of

i) growing a plant of the present invention such as to obtain oil-containing seeds thereof,
ii) harvesting said seeds, and
iii) extracting oil comprising mead acid from said seeds harvested in step ii.

Preferably, the oil is an oil as described herein above. In particular, the oil shall have a mead acid content as described above.

As set forth above, the present invention pertains to plants that produce VLC-PUFAs (and to plants that produce Mead acid). Said plants shall comprise one or more T-DNAs comprising expression cassettes for certain desaturases and elongases as explained herein in detail. Preferably, said expression cassettes are comprised by the same T-DNA (or construct).

In an embodiment of the present invention, the T-DNA or construct of the present invention further comprises at least one expression cassette comprising a polynucleotide encoding for an acetohydroxy acid synthase (abbreviated AHAS enzyme, also known a acetolactate synthase), wherein said acetohydroxy acid synthase confers tolerance to an herbicide of the imidazolinone class. Thus, the AHAS enzyme is preferably a mutated AHAS enzyme.

Mutated AHAS enzymes that confer tolerance to an herbicide of the imidazolinone class are known in the art and e.g. disclosed in WO 2008/124495 which herewith is incorporated by reference in its entirety. In an embodiment, the matutated AHAS enzyme is a mutated Arabidopsis thaliana AHAS enzyme. As compared to the wild-type enzyme, the envisaged enzyme is mutated at two positions. The envisaged enzyme has at position 653 a serine replaced by an asparagine and at position 122 an alanine replaced by a threonine.

Also preferably, the polynucleotide encoding for an AHAS enzyme which confers tolerance to an herbicide of the imidazolinone class is selected from:

a) a nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NO: 277,
b) a nucleic acid sequence encoding a polypeptide having an amino acid sequence as shown in SEQ ID NO:278.
c) a nucleic acid sequence being at least 70%, 80%, or 90% identical to the nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NO: 277,
d) a nucleic acid sequence encoding a polypeptide which is at least 60%, 70%, 80, or 90% identical to a polypeptide having an amino acid sequence as shown in SEQ ID NO: 278 , and
e) a nucleic acid sequence which is capable of hybridizing under stringent conditions to i) a nucleic acid sequence having a nucleotide sequence as shown in SEQ ID NO: 277, or to ii) a nucleic acid sequence encoding a polypeptide having an amino acid sequence as shown in SEQ ID NO:278.

Is is to be understood that the polypetide encoded by the said polynucleotide shall confer tolerance to an herbicide of the imidazolinone class. In an embodiment, the polypeptide thus shall have a serine-to-asparagine substitution at the position corresponding to position 653 of SEQ ID NO:278, and/or an alanine-to-threonin substitution at the position corresponding to position 122 of SEQ ID NO:278.

The herbicide of the imidazolinone class is preferably selected from imazethapyr, imazapic, imazamox, imazaquin, imazethabenz, and imazapyr, in particular imazamox (IUPAC: (R/S)-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-methoxymethylnicotinic acid). More specifically, the herbicide of the imidazolinone class can be selected from, but is not limited to, 2- (4-isopropyl-4-methyl-5-oxo- 2-imidiazolin-2-yl) -nicotinic acid, [2- (4-isopropyl)-4-] [methyl-5-oxo-2-imidazolin-2-yl)-3-quinolinecarboxylic] acid, [5-ethyl-2- (4-isopropyl-] 4-methyl-5-oxo-2- imidazolin-2-yl) -nicotinic acid, 2- (4-isopropyl-4-methyl-5-oxo-2- imidazolin-2-yl)- 5- (methoxymethyl)-nicotinic acid, [2- (4-isopropyl -4-methyl-5-oxo-2-] imidazolin-2- yl)-5-methylnicotinic acid. The use of 5-ethyl-2- (4-isopropyl-4-methyl-5-oxo- 2- imidazolin-2-yl) -nicotinic acid and [2- (4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-] yl)-5- (methoxymethyl)-nicotinic acid is preferred. The use of [2- (4-isopropyl-4-] methyl-5-oxo-2-imidazolin-2-yl)-5- (methoxymethyl)-nicotinic acid is particularly preferred.

In addition, the present invention relates to a method of controlling weeds in the vicinity of a plant of the present invention, said method comprising applying at least one herbicide of the imidazolinone class to the weeds and to the plant of the present invention, thereby suppressing growth of the weeds in the vicinity of a plant of the present invention.

The plant of the present invention in the context with the aforementioned method shall comprise the expression cassettes for the desaturases and elongases as explained elsewhere herein (preferably, at least one T-DNA comprising the expression cassettes) and an expression cassette comprising a polynucleotide encoding for an acetohydroxy acid synthase, wherein said acetohydroxy acid synthase confers tolerance to an herbicide of the imidazolinone class. In an embodiment, the expression cassettes for the desaturases and elongases and the comprising a polynucleotide encoding for an acetohydroxy acid synthase are comprised by the same T-DNA. The present invention also relates to the aforementioned plant.

Preferably, the polynucleotide encoding for an acetohydroxy acid synthase as set forth above is overexpressed. In an embodiment, said polynucleotide is operably linked to a constitutive promoter. In an embodiment said constitutive promoter is a CaMV 35S promoter. In another embodiment, said constitutive promoter is a parsley ubiquitin promoter (such as the promoter used for the expression of the mutated AHAS genes in the examples, for the position in SEQ ID NO; 3, see table 11).

Thus, preferred plants of the current invention contain a gene for resistance to imidazolinone class of herbicides, which inhibit the aceto-hydroxy acid synthase (AHAS) gene of plants. The gene that confers resistance is a modified variant of AHAS. The expression cassettes for the polynucleotide encoding for an acetohydroxy acid synthase may be comprised by the same T-DNA as the expression cassettes for the elongases and desaturases as referred to herein, or by a different T-DNA. Preferably, the expression cassettes are comprised by the same T-DNA.

In an embodiment, the T-DNA or construct of the present invention comprises polynucleotides encoding the following enzymes (in particular in this order): Delta-6 ELONGASE from Physcomitrella patens; Delta-5 DESATURASE from Thraustochytrium sp. ATCC21685; Delta-6 DESATURASE from Ostreococcus tauri; Delta-6 ELONGASE from Thalassiosira pseudonana; Delta-12 DESATURASE from Phythophthora sojae; Omega-3 DESATURASE from Pythium irregulare; Omega-3-DESATURASE from Phythophthora infestans; Delta-5 DESATURASE from Thraustochytrium sp (in particular sp. ATCC21685); Delta-4 DESATURASE from Thraustochytrium sp.; Omega-3 DESATURASE from Pythium irregulare; Delta-4 DESATURASE from Pavlova lutheri; Delta-5 ELONGASE from Ostreococcus tauri, and an acetohydroxy acid synthase, which confers tolerance to imidazolinone herbicides (see definitions above). The sequences of the polynucleotides and polypeptides are given e.g. in Table 130.

Insterestingly, the enzyme AHAS shares a common metabolic precursor with fatty acid biosynthesis (pyruvate). One result of the overexpression of AHAS could be increased consumption of pyruvate, leading to a reduction in oil content and potentially an increase in amino acid or protein content (see for example Blombach et al 2009, Applied and Environment Microbiology 75(2):419-427, where overexpression of AHAS results in increased lysine

production in bacteria; see also Muhitch 1988 Plant Physiol 83:23-27, where the role of AHAS in amino acid supply is described). Therefore, it is surprising that overexpression of an AHAS variant, especially in combination with the AHAS inhibiting herbicide, did not result in changes to protein, oil, or VLC-PUFA content in seeds (see example 18). As such, the present invention provides for a method of production of VLC-PUFA in which field grown plants are sprayed with an AHAS-inhibiting herbicide. Preferably, said herbicide is of the imidazolinone class.
The invention is further described by means of accompanying examples and figures, which, however, are not intended to limit the scope of the invention described herein.

EXAMPLES

Example 1: General cloning methods

Cloning methods as e.g. use of restriction endonucleases to cut double stranded DNA at specific sites, agarose gel electrophoreses, purification of DNA fragments, transfer of nucleic acids onto nitrocellulose and nylon membranes, joining of DNA-fragments, transformation of *E. coli* cells and culture of bacteria were performed as described in Sambrook et al. (1989) (Cold Spring Harbor Laboratory Press: ISBN 0-87965-309-6). Polymerase chain reaction was performed using Phusion™ High-Fidelity DNA Polymerase (NEB, Frankfurt, Germany) according to the manufactures instructions. In general, primers used in PCR were designed such, that at least 20 nucleotides of the 3' end of the primer anneal perfectly with the template to amplify. Restriction sites were added by attaching the corresponding nucleotides of the recognition sites to the 5' end of the primer. Fusion PCR, for example described by K. Heckman and L. R. Pease, Nature Protocols (2207) 2, 924–932 was used as an alternative method to join two fragments of interest, e.g. a promoter to a gene or a gene to a terminator. Gene Synthesis, as for example described by Czar et al. (Trends in Biotechnology, 2009, 27(2): 63-72), was performed by Life Technologies using their Geneart® service. The Geneart® technology, described in WO2013049227 allows production of genetic elements of a few basepair (bp) in length, and was used in this invention to produce entire plasmids of about 60,000bp. Chemical synthesis of nucleotides to polynucleotides was employed for short DNA fragments, which were then combined in a sequential, modular fashion to fragments of increasing size using a combination of conventional cloning techniques as described in WO2013049227.

Example 2: Different types of plant transformation plasmids suitable to transfer of multiple expression cassettes encoding multiple proteins into the plant genome.

For agrobacteria based plant transformation, DNA constructs preferably meet a number of criteria: (1) The construct carries a number of genetic elements that are intended to be inserted into the plant genome on a so called Transfer DNA (T-DNA) between a 'T-DNA Left Border' (LB) and 'T-DNA Right Border' (2) The construct replicates in *E.coli*, because most cloning steps require DNA multiplication steps in *E.coli*. (3) The construct replicates in *Agrobacterium* (e.g. *A. tumefaciens* or *A. rhizogenes*), because the plant transformation methods rely on using *Agrobacterium* to insert the genetic elements of interest into the plant genome of a cell that was infected by *Agrobacterium*. (4) The construct contains supporting genetic elements that encode proteins which are required for infection of the plant cell, and for transfer and integration of desired genetic elements into the plant genome of an plant cell infected by the *Agrobacterium*, or the construct was used in combination with a second construct containing such supporting genetic elements that was present in the same Agrobacterium cell. (5) The constructs can contain selection markers to facilitate selection or identification of bacterial cells that contain the entire construct, and of a plant cell(s) that contains the desired genetic elements. An overview of available plasmids was given in Komori et al (2007).

Agrobacteria mediated transformation results in an almost random integration (with some bias induced by a number of factors) of the desired genetic element into chromosomes of the plant cell. The goal of the transformation was to integrate the entire T-DNA from T-DNA Left border to T-DNA Right border into a random position of a random chromosome. It can also be desirable to integrate the entire T-DNA twice or three times into the genome, for example to increase the plant expression levels of genes encoded by the T-DNA. To avoid complex Mendelian segregation of multiple integrations, it was preferred to have all T-DNA insertions at one genomic location, ('locus'). Inserting more than 25,000 bp T-DNA into plant genomes has been found to be a particular challenge in the current invention. In particular, it has been found in this invention plasmids carrying a ColE1/pVS1 origin of replication for plasmid replication in *E.coli* and/or *Agrobacterium*, are not stable above ~25,000 bp. Such plasmids of the invention are described in Example 3. Because of this limitation, not more than ~4 to 5 gene expression cassettes can be transferred on one T-DNA containing plasmid into the plant genome. However, for the current invention up to 13 gene expression cassettes having a combined size of about 44,000 bp needed to be transferred into the plant genome. In contrast to plasmids containing the ColE1/pVS1 origin of replication for high copy plasmid replication in *E.coli* and/or *Agrobacterium*, BiBAC plasmids (Hammilton 1997) containing the F factor / pRi origin of replication for single copy plasmid replication in *E.coli* and/or *Agrobacterium* where found to be stable in this invention up to a size of ~60,000 bp. Such plasmids of the invention are described in Example 4. Both approaches described above were followed in the current invention.

Example 3: Assembly of genes required for EPA and DHA synthesis within T-plasmids containing the ColE1/pVS1 origin of replication

For synthesis of VLC-PUFA in *Brassica napus* seeds, the set of genes encoding the proteins of the metabolic VLC-PUFA pathway were combined with expression elements (promoters, terminators, Introns) and transferred into binary t-plasmids that were used for agrobacteria mediated transformation of plants. Attributed to the large number of expression cassettes promoting expression of one protein each, two binary t-plasmids where used for cloning of the complete set of proteins required for EPA and DHA synthesis. To this end, the general cloning strategy depicted in Figure 3 was employed. While Figure 3 depicts the general strategy, cloning of the final plant expression vectors described in example 10 to 14 was not restricted to this strategy; specifically a combination of all methods known to one skilled in the art, such as cloning, the use of restriction endonucleases for generation of sticky and blunt ends, synthesis and fusion PCR has been used. Following the modular cloning scheme depicted in Figure 3, genes were either synthesized by GeneArt (Regensburg) or PCR-amplified using Phusion™ High-Fidelity DNA Polymerase (NEB, Frankfurt, Germany) according to the manufacturer's instructions from cDNA. In both cases an *Nco* I and/or *Asc* I restriction site at the 5' terminus, and a *Pac* I restriction site at the 3’ terminus (Figure 3A) were introduced to enable cloning of these genes between functional elements such as promoters and terminators using these restriction sites (see below in this example). Promoter-terminator modules or promoter-intron-terminator modules were created by complete synthesis by GeneArt (Regensburg) or by joining the corresponding expression elements using fusion PCR as described in example 1 and cloning the PCR-product into the TOPO-vector pCR2.1 (Invitrogen) according to the manufacturer’s instructions (Figure 3B). While joining terminator sequences to promoter sequences or promoter-intron sequences either via synthesis of whole cassettes or using fusion PCR, recognition sequences for the restriction endonucleases depicted in Figure 3 were added to either side of the modules, and the recognition sites for the restriction endonucleases *Nco* I, *Asc* I and *Pac* I were introduced between promoter and terminator or between introns and terminator (see Figure 3B). To obtain the final expression modules, PCR-amplified genes were cloned between promoter and terminator or intron and terminator via *Nco* I and/or *Pac* I restriction sites (Figure 3C). Employing the custom multiple cloning site (MCS) up to three of those expression modules were combined as desired to expression cassettes harbored by either one of pENTR/A, pENTR/B or pENTR/C (Figure 3D). Finally, the Multi-site Gateway™ System (Invitrogen) was used to combine three expression cassettes harbored by pENTR/A, pENTR/B and pENTR/C (Figure 3E) to obtain the final binary pSUN T-plasmids for plant transformation: VC-LJB2197-1qcz, VC-LJB2755-2qcz rc, VC-LLM306-1qcz rc, VC-LLM337-1qcz rc, VC-LLM338-3qcz rc and VC-LLM391-2qcz rc. An overview of binary vectors and their usage was given by Hellens *et al*, Trends in Plant Science (2000) 5: 446–451.

The structure of the plamsids VC-LJB2197-1qcz, VC-LJB2755-2qcz rc, VC-LLM306-1qcz rc, VC-LLM337-1qcz rc, VC-LLM338-3qcz rc, VC-LLM391-2qcz rc, and VC-LTM217-1qcz rc was given in the Table 1, Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7

Nomeclature of genetic elements:

j- indicates a junction between two genetic elements
c- coding sequence
t- terminator
p- promoter
i- intron
T-DNA Transferred DNA
RB Right Border of the T-DNA
LB Left Border of the T-DNA

Table 1 Genetic Elements of plasmid VC-LJB2197-1qcz. Listed are the names of the elements, the position in VC-LJB2197-1qcz (note: start position was larger than stop position for elements encoded by the complementary strand of VC-LJB2197-1qcz), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LJB2197-1qcz) and a left border (nucleotides 22232 to 22105 of VC-LJB2197-1qcz). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E.coli* and/or agrobacteria.

Genetic Elements of plasmid VC-LJB2197-1qcz	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA
p-VfUSP_684bp[LLL894]	329	1012	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	1013	1264	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-d6Elo(Pp_GA2)	1267	2139	*Delta-6 ELONGASE* from *Physcomitrella patens*
t-CaMV35S	2140	2355	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-LuCnl(1064bp)	2448	3511	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss14_377[LJK32]	3512	3888	i-Atss14_377bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d5Des(Tc_GA2)	3892	5211	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-AgrOCS 192bp[LED12]	5212	5403	Terminator from *OCTOPINE SYNTHASE* gene OCS from *Agrobacterium tumefaciens*
p-SBP	5539	7337	Promoter from a *SUCROSE-BINDING PROTEIN-RELATED* gene from *Vicia faba*
i-Atss2_455bp[LJK20]	7338	7792	i-Atss2_455bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d6Des(Ot_febit)	7802	9172	*Delta-6 DESATURASE* from *Ostreococcus tauri*
t-StCATHD-pA	9200	9434	Terminator from *CATHEPSIN D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]
p-LuPXR 1727bp[LLL823]	9513	11239	Promoter from *PEROXIREDOXIN LIKE PROTEIN* gene *PXR* from *Linum usitatissimum*

Genetic Elements of plasmid VC-LJB2197-1qcz	From	To	Description, Function and Source of Element
i-Atss1_847bp[LJK19]	11240	12086	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d6Elo(Tp_GA2)	12100	12918	*Delta-6 ELONGASE* from *Thalassiosira pseudonana*
t-AtPXR 400bp[LLL823]	12974	13373	Terminator from *PEROXIREDOXIN LIKE PROTEIN* gene *PXR* (At1g48130) from *Arabidopsis thaliana*
p-Napin A/B	13543	14206	Promoter from *napA/B* gene (napin, seed storage protein) from *Brassica napus*
i-Atss14_377[LJK32]	14207	14583	i-Atss14_377bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d12Des(Ps_GA)	14590	15786	*Delta-12 DESATURASE* from *Phythophthora sojae*
t-E9	15805	16362	Terminator from Small Subunit of RuBisCo *rbcS* gene (*E9*) from *Pisum sativum*
t-AtAHAS-3'/UTR[bb003]	16576	17790	Terminator from *AtAHASL* [*csr1-2*] of *acetohydroxyacid synthase* gene from *Arabidopsis*
p-PcUbi4-2[long]	17823	18804	Promoter from *UBIQUITIN* gene *UBI4-2* with internal intron from *Petroselinum crispum*
c-AtAHASL_A122T_S653N	18812	20824	*ACETOHYDROXYACID SYNTHASE LARGE-SUBUNIT* gene/CDS with S653N(*csr1-2*) mutation and A122T SDM mutation from *Arabidopsis*
t-AtAHAS-3'/UTR[ac321]	20849	22064	Terminator from *AtAHASL* [*csr1-2*] of *ACETOHYDROXYACID SYNTHASE* gene from *Arabidopsis*
b-JTV_LB	22232	22105	Left border of T-DNA
c-StaA[lm500]	22338	22967	PVS1 partitioning protein
c-VS1orf3[lm500]	23203	22988	*VS1*orf3
c-repA[lm500]	23294	24469	pVS1 replication protein [*repA*] gene/CDS
o-pVS1-origin	24535	24729	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	25032	24830	pBR322 bom site, partial, from AF234316 pCambia2301

Genetic Elements of plasmid VC-LJB2197-1qcz	From	To	Description, Function and Source of Element
o-Rep-ColE1	25451	25171	pBR322 origin of replication [ecoli] from AF234316 pCambia2301
c-aadAmod1	26588	25797	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	26767	26589	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Table 2: Genetic Elements of plasmid VC-LJB2755-2qcz rc. Listed are the names of the elements, the position in VC-LJB2755-2qcz rc (note: start position was larger than stop position for elements encoded by the complementary strand of VC-LJB2755-2qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LJB2755-2qcz rc) and a left border (nucleotides 26117 to 25990 of VC-LJB2755-2qcz rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in ***E.coli*** and/or agrobacteria.

Genetic Elements of plasmid VC-LJB2755-2qcz rc	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA
p-LuPXR 1727bp[LLL823]	342	2068	Promoter from *PEROXIREDOXIN LIKE PROTEIN* gene *PXR* from *Linum usitatissimum*
i-Atss15_758bp[LJK33]	2069	2826	i-Atss15_758bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pir_GA)	2842	3933	*Omega-3 DESATURASE* from *Pythium irregulare*
t-AtPXR 400bp[LLL823]	3990	4389	Terminator from *PEROXIREDOXIN LIKE PROTEIN* gene *PXR* (At1g48130) from *Arabidopsis thaliana*
p-LuCnl(1064bp)	4468	5531	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss14_377[LJK32]	5532	5908	i-Atss14_377bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d5Des(Tc_GA2)	5912	7231	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-AgrOCS 192bp[LED12]	7232	7423	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-SBP	7559	9357	Promoter from a *SUCROSE BINDING RELATED-PROTEIN* gene from *Vicia faba*
i-Atss2_455bp[LJK20]	9358	9812	i-Atss2_455bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d6Des(Ot_febit)	9822	11192	*Delta-6 DESATURASE* from *Ostreococcus tauri*

Genetic Elements of plasmid VC-LJB2755-2qcz rc	From	To	Description, Function and Source of Element
t-StCATHD-pA	11220	11454	Terminator from *CATHEPSIN D INHIBITOR* gene [CATHD] from *Solanum tuberosum* [Potato]
p-BnFae1	11533	12962	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	12963	13809	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d6Elo(Tp_GA2)	13812	14630	*Delta-6 ELONGASE* from *Thalassiosira pseudonana*
t-bnFae1	14646	15045	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-Napin A/B	15166	15829	Promoter from *napA/B* gene (napin, seed storage protein) from *Brassica napus*
i-Atss14_377[LJK32]	15830	16206	i-Atss14_377bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d12Des(Ps_GA)	16213	17409	*Delta-12 DESATURASE* from *Phythophthora sojae*
t-E9	17428	17985	Terminator from Small Subunit of RuBisCo *rbcS* gene (*E9*) from *Pisum sativum*
p-VfUSP_684bp[LLL894]	18064	18747	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	18748	18999	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	19010	20095	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	20104	20319	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus

Genetic Elements of plasmid VC-LJB2755-2qcz rc	From	To	Description, Function and Source of Element
t-AtAHAS-3'/UTR[ac321]	20460	21675	Terminator from *AtAHASL* [*csr1-2*] of *ACETYOHYDROXYACID SYNTHASE* gene from *Arabidopsis*
p-PcUbi4-2[long]	21708	22689	Promoter from *UBIQUITIN* gene *UBI4-2* with internal intron from *Petroselinum crispum*
c-AtAHASL_A122T_S653N	22697	24709	*ACETOHYDROXYACID SYNTHASE LARGE-SUBUNIT* gene/CDS with S653N(*csr1-2*) mutation and A122T SDM mutation from *Arabidopsis*
t-AtAHAS-3'/UTR[ac321]	24734	25949	Terminator from *AtAHASL* [*csr1-2*] of *ACETOHYDROXYACID SYNTHASE* gene from *Arabidopsis*
b-JTV_LB	26117	25990	Left border of T-DNA
c-StaA[lm500]	26223	26852	PVS1 partitioning protein
c-VS1orf3[lm500]	27088	26873	*VS1*orf3
c-repA[lm500]	27179	28354	pVS1 replication protein [*repA*] gene/CDS
o-pVS1-origin	28420	28614	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	28917	28715	pBR322 bom site, partial, from AF234316 pCambia2301
o-Rep-ColE1	29336	29056	pBR322 origin of replication [*E. coli*] from AF234316 pCambia2301
c-aadAmod1	30473	29682	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	30652	30474	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Table 3: Genetic Elements of plasmid VC-LLM306-1qcz rc. Listed are the names of the elements, the position in VC-LLM306-1qcz rc (note: start position was larger than stop position for elements encoded by the complementary strand of VC-LLM306-1qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LLM306-1qcz rc) and a left border (nucleotides 20180 to 20053 of VC-LLM306-1qcz rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in ***E.coli*** and/or agrobacteria.

Genetic Elements of plasmid VC-LLM306-1qcz rc	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA

Genetic Elements of plasmid VC-LLM306-1qcz rc	From	To	Description, Function and Source of Element
p-LuCnl(1064bp)	342	1405	Promoter from *CONLININ* gene from *Linum usitatissimum*
c-d4Des(Eg_GA)	1416	3041	*Delta 4 DESATURASE* from *Euglena gracilis*
t-AgrOCS 192bp[LED12]	3063	3254	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-BnFAE1	3448	4877	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	4878	5724	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	5732	6634	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFAE1	6651	7050	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-VfSBP_perm3	7099	8897	Promoter derived from a promoter from a *SUCROSE-BINDING PROTEIN-RELATED* gene from *Vicia faba*
c-o3Des(Pir_GA)	8901	9992	*Omega-3 DESATURASE* from *Pythium irregulare*
t-StCATHD-pA	10023	10257	Terminator from *CATHEPSIN D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]
p-VfUSP_684bp[LLL894]	10331	11014	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss15_758bp[LJK33]	11015	11772	i-Atss15_758bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	11789	12874	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	12924	13139	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-ARC5_perm1	13259	14409	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*

Genetic Elements of plasmid VC-LLM306-1qcz rc	From	To	Description, Function and Source of Element
c-d4Des(Tc_GA)	14420	15979	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	15993	16592	Terminator of *ARC5* gene from *Phaseolus vulgaris*
p-BnFae1	16671	18100	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
c-d6Des(Ot_febit)	18109	19479	*Delta-6 DESATURASE* from *Ostreococcus tauri*
t-bnFae1	19493	19892	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
b-JTV_LB	20180	20053	Left border of T-DNA
c-StaA[lm500]	20286	20915	PVS1 partitioning protein
c-VS1orf3[lm500]	21151	20936	*VS1*orf3
c-repA[lm500]	21242	22417	pVS1 replication protein [*repA*] gene/CDS
o-pVS1-origin	22483	22677	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	22980	22778	pBR322 bom site, partial, from AF234316 pCambia2301
o-Rep-ColE1	23399	23119	pBR322 origin of replication [*E. coli*] from AF234316 pCambia2301
c-aadAmod1	24536	23745	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	24715	24537	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Table 4: **Genetic Elements of plasmid VC-LLM337-1qcz rc. Listed are the names of the elements, the position in VC-LLM337-1qcz rc (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of VC-LLM337-1qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LLM337-1qcz rc) and a left border (nucleotides 16953 to 16826 of VC-LLM337-1qcz rc. Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E.coli* and/or agrobacteria.**

Genetic Elements of plasmid VC-LLM337-1qcz rc	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA

Genetic Elements of plasmid VC-LLM337-1qcz rc	From	To	Description, Function and Source of Element
p-LuCnl(1064bp)	342	1405	Promoter from *CONLININ* gene from *Linum usitatissimum*
c-d4Des(Eg_GA)	1416	3041	*Delta-4 DESATURASE* from *Euglena gracilis*
t-AgrOCS 192bp[LED12]	3063	3254	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-BnFae1	3448	4877	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	4878	5724	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	5732	6634	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	6651	7050	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-VfSBP_perm3	7099	8897	Promoter derived from a promoter from a *SUCROSE-BINDING PROTEIN-RELATED* gene from *Vicia faba*
c-o3Des(Pir_GA)	8901	9992	*Omega-3 DESATURASE* from *Pythium irregulare*
t-StCATHD-pA	10023	10257	Terminator from *CATHEPSIN D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]
p-VfUSP_684bp[LLL894]	10331	11014	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss15_758bp[LJK33]	11015	11772	i-Atss15_758bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	11789	12874	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	12924	13139	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-ARC5_perm1	13259	14409	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*

Genetic Elements of plasmid VC-LLM337-1qcz rc	From	To	Description, Function and Source of Element
c-d4Des(Tc_GA)	14420	15979	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	15993	16592	Terminator of *ARC5* gene from *Phaseolus vulgaris*
b-JTV_LB	16953	16826	Left border of T-DNA
c-StaA[lm500]	17059	17688	PVS1 partitioning protein
c-VS1orf3[lm500]	17924	17709	*VS1* orf3
c-repA[lm500]	18015	19190	pVS1 replication protein [repA] gene/CDS
o-pVS1-origin	19256	19450	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	19753	19551	pBR322 bom site, partial, from AF234316 pCambia2301
o-Rep-ColE1	20172	19892	pBR322 origin of replication [*E. coli*] from AF234316 pCambia2301
c-aadAmod1	21309	20518	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	21488	21310	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Table 5: Genetic Elements of plasmid VC-LLM338-3qcz rc. Listed are the name of the element, the position in VC-LLM338-3qcz rc (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand VC-LLM338-3qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LLM338-3qcz rc) and a left border (nucleotides 17069 to 16942 of VC-LLM338-3qcz rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E.coli* and/or agrobacteria.

Genetic Elements of plasmid VC-LLM338-3qcz rc	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA
p-VfSBP_perm3	341	2139	Promoter derived from a promoter from a *SUCROSE-BINDING RELATED-PROTEIN* gene from *Vicia faba*
c-d15Des(Ch_ERTp_GA)	2151	3389	*Delta-15 DESATURASE* from *Cochliobolus heterostrophus* C5
t-StCATHD-pA	3420	3654	Terminator from *CATHEPSIN D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]

Genetic Elements of plasmid VC-LLM338-3qcz rc	From	To	Description, Function and Source of Element
p-BnFae1	3848	5277	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	5278	6124	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	6132	7034	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	7051	7450	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-VfUSP_684bp[LLL894]	7529	8212	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss15_758bp[LJK33]	8213	8970	i-Atss15_758bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	8987	10072	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	10122	10337	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-ARC5_perm1	10457	11607	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*
c-d4Des(Tc_GA)	11618	13177	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	13191	13790	Terminator of *ARC5* gene from *Phaseolus vulgaris*
p-LuCnl(1064bp)	13869	14932	Promoter from *CONLININ* gene from *Linum usitatissimum*
c-d4Des(Eg_GA)	14943	16568	*Delta-4 DESATURASE* from *Euglena gracilis*
t-AgrOCS 192bp[LED12]	16590	16781	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
b-JTV_LB	17069	16942	Left border of T-DNA
c-StaA[lm500]	17175	17804	PVS1 partitioning protein
c-VS1orf3[lm500]	18040	17825	*VS1*orf3

Genetic Elements of plasmid VC-LLM338-3qcz rc	From	To	Description, Function and Source of Element
c-repA[lm500]	18131	19306	pVS1 replication protein [*repA*] gene/CDS
o-pVS1-origin	19372	19566	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	19869	19667	pBR322 bom site, partial, from AF234316 pCambia2301
o-Rep-ColE1	20288	20008	pBR322 origin of replication [*E. Coli*] from AF234316 pCambia2301
c-aadAmod1	21425	20634	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	21604	21426	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Table 6: Genetic Elements of plasmid VC-LLM391-2qcz rc rc. Listed are the names of the elements, the position in VC-LLM391-2qcz rc rc (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of VC-LLM391-2qcz rc rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LLM391-2qcz rc rc) and a left border (nucleotides 10947 to 10820 of VC-LLM391-2qcz rc rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E.coli* and/or agrobacteria.

Genetic Elements of plasmid VC-LLM391-2qcz rc	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA
p-BnFae1	540	1969	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	1970	2816	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	2824	3726	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	3743	4142	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520) gene of *Arabidopsis thaliana*
p-ARC5perm1	4335	5485	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*

Genetic Elements of plasmid VC-LLM391-2qcz rc	From	To	Description, Function and Source of Element
c-d4Des(Tc_GA)_T564G	5496	7055	*Delta-4 DESATURASE* from *Thraustochytrium* spp.
t-pvarc	7069	7668	Terminator of *Arc5* gene from *Phaseolus vulgaris*
p-LuCnl(1064bp)	7747	8810	Promoter from *CONLININ* gene from *Linum usitatissimum*
c-d4Des(Eg_GA)	8821	10446	*Delta-4 DESATURASE* from *Euglena gracilis*
t-AgrOCS 192bp[LED12]	10468	10659	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
b-JTV_LB	10947	10820	Left border of T-DNA
c-StaA[lm500]	11053	11682	PVS1 partitioning protein
c-VS1orf3[lm500]	11918	11703	*VS1*orf3
c-repA[lm500]	12009	13184	pVS1 replication protein [*repA*] gene/CDS
o-pVS1-origin	13250	13444	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	13747	13545	pBR322 bom site, partial, from AF234316 pCambia2301
o-Rep-ColE1	14166	13886	pBR322 origin of replication [*E. coli*] from AF234316 pCambia2301
c-aadAmod1	15303	14512	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	15482	15304	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Table 7: **Genetic Elements of plasmid VC-LLTM217-1qcz rc. Listed are the names of the elements, the position in VC-LLTM217-1qcz rc (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of VC-LLTM217-1qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 148 to 4 of VC-LLTM217-1qcz rc) and a left border (nucleotides 10659 to 10532 of VC-LLTM217-1qcz rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in E.coli and/or agrobacteria.**

Genetic Elements of plasmid VC-LTM217-1qcz rc	From	To	Description, Function and Source of Element
b-RB[lm175]	148	4	Right border of T-DNA
p-BnFae1	540	1969	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*

Genetic Elements of plasmid VC-LTM217-1qcz rc	From	To	Description, Function and Source of Element
i-Atss1_847bp[LJK19]	1970	2816	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	2824	3726	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	3743	4142	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-ARC5_perm1	4335	5485	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*
c-d4Des(Tc_GA)	5496	7055	*Delta-4 DESATURASE* from *Thraustochytrium* spp.
t-pvarc	7069	7668	Terminator of *Arc5* gene from *Phaseolus vulgaris*
p-LuCnl(1064bp)	7747	8810	Promoter from *CONLININ* gene from *Linum usitatissimum*
c-d4Des(Pl_GA)2	8821	10158	*Delta-4 DESATURASE* from *Pavlova lutheri*
t-AgrOCS 192bp[LED12]	10180	10371	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
b-JTV_LB	10659	10532	Left border of T-DNA
c-StaA[lm500]	10765	11394	PVS1 partitioning protein
c-VS1orf3[lm500]	11630	11415	*VS1*orf3
c-repA[lm500]	11721	12896	pVS1 replication protein [*repA*] gene/CDS
o-pVS1-origin	12962	13156	broad host-range replication origin of plasmid pVS1 (Genbank: AF133831, Itoh et al.1984)
o-ColE1-bom[lm500]	13459	13257	pBR322 bom site, partial, from AF234316 pCambia2301
o-Rep-ColE1	13878	13598	pBR322 origin of replication [*E. coli*] from AF234316 pCambia2301
c-aadAmod1	15015	14224	Codon Optimized *Adenyltransferase* [*aadA*] gene/CDS from SUN100
p-aadA[lm800]	15194	15016	*Adenyltransferase* [*aadA*] Spectinomycin Prokaryotic promoter

Example 4: Assembly of genes required for EPA and DHA synthesis within BiBAC T-plasmids containing the F factor / pRI origin of replication

For synthesis of VLC-PUFA in *Brassica napus* seeds, the set of genes encoding the proteins of the metabolic VLC-PUFA pathway were combined with expression elements (promoters, terminators and introns) and transferred into binary t-plasmids that were used for agrobacteria mediated transformation of plants. While the large number of expression cassettes promoting expression of one protein each, were distributed in example 3 onto two binary t-plasmids T-DNA, in this example all expression cassettes have been combined onto a single binary T-plasmid. The advance of DNA synthesis allows numerous companies to offer services to use a combination of chemical synthesis and molecular biological techniques to synthesize de novo, without an initial template, polynucleotides up to the size of microbial genomes. Synthesis used in the construction of the plasmids described in this example was performed by Life Technologies using their Geneart® service. The Geneart® technology, described in WO2013049227 allows production of genetic elements of a few basepair (bp) length, and was used in this invention to produce the binary T-plasmids for plant transformation VC-RTP10690-1qcz_F, VC-RTP10691-2qcz, VC-LTM595-1qcz rc and VC-LTM593-1qcz rc having a total size of ~61.000bp for each construct. The structure of the plasmids VC-RTP10690-1qcz_F, VC-RTP10691-2qcz, VC-LTM595-1qcz rc and VC-LTM593-1qcz rc is given in: Table 8, Table 9, Table 10 and Table 11.

Table 8: Genetic Elements of plasmid RTP10690-1qcz_F. Listed are the names of the elements, the position in RTP10690-1qcz_F (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of SEQ ID NO.6), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 59918 to 148 of RTP10690-1qcz_F) and a left border (nucleotides 43853 to 43718 of RTP10690-1qcz_F). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E.coli* and/or agrobacteria.

Genetic Elements of plasmid RTP10690-1qcz_F	From	To	Description, Function and Source of Element
p-VfUSP_684bp[LLL894]	329	1012	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	1013	1264	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-d6Elo(Pp_GA2)	1267	2139	*Delta-6 ELONGASE* from *Physcomitrella patens*
t-CaMV35S	2140	2355	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus

Genetic Elements of plasmid RTP10690-1qcz_F	From	To	Description, Function and Source of Element
p-LuCnl(1064bp)	2448	3511	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss14_377bp[LJK32]	3512	3888	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d5Des(Tc_GA2)	3892	5211	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-AgrOCS 192bp[LED12]	5212	5403	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-SBP	5539	7337	Promoter from a *SUCROSE-BINDING PROTEIN-RELATED* gene from *Vicia faba*
i-Atss2_455bp[LJK20]	7338	7792	i-Atss2_455bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d6Des(Ot_febit)	7802	9172	*Delta-6 DESATURASE* from *Ostreococcus tauri*
t-StCATHD-pA	9200	9434	Terminator from *CATHEPSIN D INHIBITOR* gene [CATHD] from *Solanum tuberosum* [Potato]
p-LuPXR 1727bp[LLL823]	9513	11239	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss1_847bp[LJK19]	11240	12086	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.

Genetic Elements of plasmid RTP10690-1qcz_F	From	To	Description, Function and Source of Element
c-d6Elo(Tp_GA2)	12100	12918	*Delta-6 ELONGASE* from *Thalassiosira pseudonana*
t-AtPXR 400bp[LLL823]	12974	13373	Terminator from *PEROXIREDOXIN LIKE* protein gene *PXR* (At1g48130) from *Arabidopsis thaliana*
p-Napin A/B	13543	14206	Promoter from *napA/B* gene (napin, seed storage protein) from *Brassica napus*
i-Atss14_377bp[LJK32]	14207	14583	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d12Des(Ps_GA2)	14590	15786	*Delta-12 DESATURASE* from *Phythophthora sojae*
t-E9	15805	16362	Terminator from Small Subunit of RuBisCo *rbcS* gene (*E9*) from *Pisum sativum*
p-LuPXR 1727bp[LLL823]	16462	18188	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss15_758bp[LJK33]	18189	18946	i-Atss15_758bp[LJK33] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pir_GA)	18962	20053	*Omega-3 DESATURASE* from *Pythium irregulare*
t-AtPXR 400bp[LLL823]	20110	20509	Terminator from *PEROXIREDOXIN LIKE* protein gene *PXR* (At1g48130) from *Arabidopsis thaliana*
p-LuCnl(1064bp)	20645	21708	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss2_455bp[LJK20]	21709	22163	i-Atss2_455bp functional intron region; intron with partial 5'UTR,

Genetic Elements of plasmid RTP10690-1qcz_F	From	To	Description, Function and Source of Element
			Arabidopsis thaliana, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d4Des(Pl_GA)2	22181	23518	*Delta-4 DESATURASE* from *Pavlova lutheri*
t-AgrOCS 192bp[LED12]	23540	23731	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-BnFae1	23925	25354	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	25355	26202	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
T	25513	25513	T inserted [14-T string found verses 13-T string in original i-Atss1_847bp[LJK19]
c-d5Elo(Ot_GA3)	26210	27112	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	27129	27528	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-ARC5_perm1	27681	28831	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*
c-d4Des(Tc_GA3)	28842	30401	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	30415	31014	Terminator of *ARC5* gene from *Phaseolus vulgaris*
p-VfUSP_684bp[LLL894]	31093	31776	Promoter from unknown seed protein gene USP (accession: X56240) from *Vicia faba*

Genetic Elements of plasmid RTP10690-1qcz_F	From	To	Description, Function and Source of Element
i-Atss18_252[LJK36]	31777	32028	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	32039	33124	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	33133	33348	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-BnSETL-v1[1234bp]	33484	34717	*SETL*-v1 *Brassica napus* promoter
c-d5Des(Tc_GA2)	34720	36039	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-BnSETL	36061	36674	*SETL*-v1 *Brassica napus* terminator
p-BnSETL-v1[1234bp]	36767	38000	*SETL*-v1 *Brassica napus* promoter
c-o3Des(Pir_GA)	38003	39094	*Omega-3 DESATURASE* from *Pythium irregulare*
t-BnSETL	39116	39729	*SETL*-v1 *Brassica napus* terminator
p-YPC105906_PcUbi4-2[long]	39853	40829	MTX Parsley *UBI4-2* promoter with internal intron
c-AtAHASL_A122T_S653N[minusRES]	40837	42849	*ACETOHYDROXYACID SYNTHASE LARGE SUBUNIT* gene/CDS from *Arabidopsis* with S653N (*csr1-2*) mutation and A122T SDM mutation minus restriction sites
t-AtAHAS-3'UTR[rtp4820]	42850	43629	*Arabidopsis* (dicot) *AtAHASL* 3' Un-translated Region [trimmed] terminator for *ACETOHYDROXYACID SYNTHASE* gene
b-LLB	43853	43718	Left T-DNA Left border from pTi15955 [Genbank #AF242881]
c-KanR_Tn903	45800	44985	Kanamycin Resistance selection gene/CDS
p-Kan[lm500]	45921	45801	Promoter for Kanamycin resistance gene
o-ori-2	47074	47290	ori-2 origin of replication
c-repE	47384	48139	*repE* gene/CDS
c-sopA	48718	49893	*sapA* gene/CDS

Genetic Elements of plasmid RTP10690-1qcz_F	From	To	Description, Function and Source of Element
c-sopB	49893	50864	*sopB* gene/CDS
c-sopC/incD	50937	51410	*incD*/*sopC* partial gene/CDS
c-traI	51913	51972	*traI* gene/CDS
mf-traI - repA intergenic region	51961	52323	regulatory region of traR dependent quorum sensing regulon - containing 2 tra-boxes (see LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179-188)
o-repA	52324	53541	*Rep-A* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
rr-repB	53771	54781	*rep-B* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
o-repC	54996	56315	*rep-C* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
mf-y4cG	56794	56324	fragment of DNA invertase homolog; similar to Rhizobium sp. NGR234 pNGR234a Y4CG
tr-Tn5	58834	57273	Transposon Tn5 sequence
o-oriT	59130	59298	oriT from pRK310 genbank file
b-RB[rtp4394]	148	59918	Right T-DNA Right border

Table 9: Genetic Elements of plasmid RTP10691-2qcz. Listed are the names of the elements, the position in RTP10691-2qcz (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of RTP10691-2qcz), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 60923 to 148 of RTP10691-2qcz and a left border (nucleotides 44858 to 44723 of RTP10691-2qcz). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E.coli* and/or agrobacteria.

Genetic Elements of plasmid RTP10691-2qcz	From	To	Description, Function and Source of Element
p-VfUSP_684bp[LLL894]	329	1012	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*

Genetic Elements of plasmid RTP10691-2qcz	From	To	Description, Function and Source of Element
i-Atss18_252[LJK36]	1013	1264	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-d6Elo(Pp_GA2)	1267	2139	*Delta-6 ELONGASE* from *Physcomitrella patens*
t-CaMV35S	2140	2355	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-LuCnl(1064bp)	2448	3511	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss14_377bp[LJK32]	3512	3888	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d5Des(Tc_GA2)	3892	5211	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-AgrOCS 192bp[LED12]	5212	5403	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-SBP	5539	7337	Promoter from a *SUCROSE-BINDING RELATED-PROTEIN* gene from *Vicia faba*
i-Atss2_455bp[LJK20]	7338	7792	i-Atss2_455bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d6Des(Ot_febit)	7802	9172	*Delta-6 DESATURASE* from *Ostreococcus tauri*
t-StCATHD-pA	9200	9434	Terminator from *CATHEPSIS D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]

Genetic Elements of plasmid RTP10691-2qcz	From	To	Description, Function and Source of Element
p-LuPXR 1727bp[LLL823]	9513	11239	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss1_847bp[LJK19]	11240	12086	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d6Elo(Tp_GA2)	12100	12918	*Delta-6 ELONGASE* from *Thalassiosira pseudonana*
t-AtPXR 400bp[LLL823]	12974	13373	Terminator from *PEROXIREDOXIN LIKE* protein gene *PXR* (At1g48130) from *Arabidopsis thaliana*
p-Napin A/B	13543	14206	Promoter from *napA/B* gene (napin, seed storage protein) from *Brassica napus*
i-Atss14_377bp[LJK32]	14207	14583	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d12Des(Ps_GA2)	14590	15786	*Delta-12 DESATURASE* from *Phythophthora sojae*
t-E9	15805	16362	Terminator from Small Subunit of RuBisCo *rbcS* gene (*E9*) from *Pisum sativum*
p-LuPXR 1727bp[LLL823]	16462	18188	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss15_758bp[LJK33]	18189	18946	i-Atss15_758bp[LJK33] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of

Genetic Elements of plasmid RTP10691-2qcz	From	To	Description, Function and Source of Element
			transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pir_GA)	18962	20053	*Omega-3 DESATURASE* from *Pythium irregulare*
t-AtPXR 400bp[LLL823]	20110	20509	Terminator from *PEROXIREDOXIN LIKE* protein gene PXR (At1g48130) from *Arabidopsis thaliana*
p-BnSETL-v1[1234bp]	20645	21878	*SETL*-v1 *Brassica napus* promoter
c-d5Des(Tc_GA2)	21881	23200	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-BnSETL	23222	23835	*SETL*-v1 *Brassica napus* terminator
p-BnFae1	24029	25458	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	25459	26302	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
delTTT	25612	25612	Three T deleted compared to original i-Atss1_847bp[LJK19]
c-d5Elo(Ot_GA3)	26310	27212	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	27229	27628	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-ARC5_perm1	27781	28931	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*
c-d4Des(Tc_GA3)	28942	30501	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	30515	31114	Terminator of *ARC5* gene from *Phaseolus vulgaris*
p-VfUSP_684bp[LLL894]	31193	31876	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*

Genetic Elements of plasmid RTP10691-2qcz	From	To	Description, Function and Source of Element
i-Atss18_252[LJK36]	31877	32128	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	32139	33224	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	33233	33448	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-BnFae1	33642	35071	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	35072	35918	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d4Des(Pl_GA)2	35926	37263	*Delta-4 DESATURASE* from *Pavlova lutheri*
t-bnFae1	37280	37679	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-BnSETL-v1[1234bp]	37772	39005	*SETL*-v1 *Brassica napus* promoter
c-o3Des(Pir_GA)	39008	40099	*Omega-3 DESATURASE* from *Pythium irregulare*
t-BnSETL	40121	40734	*SETL*-v1 *Brassica napus* terminator
p-YPC105906_PcUbi4-2[long]	40858	41834	MTX Parsley *UBI4-2* promoter with internal intron
c-AtAHASL_A122T_S653N[minusRES]	41842	43854	*ACETOHYDROXYACID SYNTHASE LARGE SUBUNIT* gene/CDS from *Arabidopsis* with S653N (*csr1-2*) mutation and A122T SDM mutation minus restriction sites
t-AtAHAS-3'UTR[rtp4820]	43855	44634	Arabidopsis (dicot) *AtAHASL* 3' Un-translated Region [trimmed]

Genetic Elements of plasmid RTP10691-2qcz	From	To	Description, Function and Source of Element
			terminator for *ACETOHYDROXYACID SYNTHASE* gene
b-LLB	44858	44723	Left T-DNA Left border from pTi15955 [Genbank #AF242881]
c-KanR_Tn903	46805	45990	Kanamycin Resistance selection gene/CDS
p-Kan[lm500]	46926	46806	Promoter for Kanamycin resistance gene
o-ori-2	48079	48295	ori-2 origin of replication
c-repE	48389	49144	*repE* gene/CDS
c-sopA	49723	50898	*sapA* gene/CDS
c-sopB	50898	51869	*sopB* gene/CDS
c-sopC/incD	51942	52415	*incD*/ *sopC* partial gene/CDS
c-traI	52918	52977	*traI* gene/CDS
mf-traI - repA intergenic region	52966	53328	regulatory region of traR dependent quorum sensing regulon - containing 2 tra-boxes (see LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179-188)
o-repA	53329	54546	*Rep-A* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
rr-repB	54776	55786	*rep-B* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
o-repC	56001	57320	*rep-C* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
mf-y4cG	57799	57329	fragment of DNA invertase homolog; similar to *Rhizobium* sp. NGR234 pNGR234a Y4CG
tr-Tn5	59839	58278	Transposon Tn5 sequence
o-oriT	60135	60303	oriT from pRK310 genbank file
b-RB[rtp4394]	60923	148	Right T-DNA Right border

Table 10: Genetic Elements of plasmid VC-LTM595-1qcz rc. Listed are the names of the elements, the position in VC-LTM595-1qcz rc (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of VC-LTM595-1qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 60913 to 148 of VC-LTM595-1qcz rc) and a left border (nucleotides 44848 to 44713 of VC-LTM595-1qcz rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E. coli* and/or agrobacteria.

Genetic Elements of plasmid VC-LTM595-1qcz rc	From	To	Description, Function and Source of Element
p-VfUSP_684bp[LLL894]	329	1012	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	1013	1264	i-Atss18_252bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-d6Elo(Pp_GA2)	1267	2139	*Delta-6 ELONGASE* from *Physcomitrella patens*
t-CaMV35S	2140	2355	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-LuCnl(1064bp)	2448	3511	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss14_377bp[LJK32]	3512	3888	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d5Des(Tc_GA2)	3892	5211	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-AgrOCS 192bp[LED12]	5212	5403	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-SBP	5539	7337	Promoter from a *SUCROSE-BINDING RELATED-PROTEIN* gene from *Vicia faba*
i-Atss2_455bp[LJK20]	7338	7792	i-Atss2_455bp functional intron region; intron with partial 5'UTR,

Genetic Elements of plasmid VC-LTM595-1qcz rc	From	To	Description, Function and Source of Element
			Arabidopsis thaliana, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d6Des(Ot_febit)	7802	9172	*Delta-6 DESATURASE* from *Ostreococcus tauri*
t-StCATHD-pA	9200	9434	Terminator from *CATHEPSIS D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]
p-LuPXR 1727bp[LLL823]	9513	11239	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss1_847bp[LJK19]	11240	12086	i-Atss1_847bp functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d6Elo(Tp_GA2)	12100	12918	*Delta-6 ELONGASE* from *Thalassiosira pseudonana*
t-AtPXR 400bp[LLL823]	12974	13373	Terminator from *PEROXIREDOXIN LIKE* protein gene *PXR* (At1g48130) from *Arabidopsis thaliana*
p-Napin A/B	13543	14206	Promoter from *napA/B* gene (napin, seed storage protein) from *Brassica napus*
i-Atss14_377bp[LJK32]	14207	14583	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d12Des(Ps_GA2)	14590	15786	*Delta-12 DESATURASE* from *Phythophthora sojae*

Genetic Elements of plasmid VC-LTM595-1qcz rc	From	To	Description, Function and Source of Element
t-E9	15805	16362	Terminator from Small Subunit of RuBisCo *rbcS* gene (*E9*) from *Pisum sativum*
p-LuPXR 1727bp[LLL823]	16455	18181	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss15_758bp[LJK33]	18182	18939	i-Atss15_758bp[LJK33] functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pir_GA)	18955	20046	*Omega-3 DESATURASE* from *Pythium irregulare*
t-AtPXR 400bp[LLL823]	20103	20502	Terminator from *PEROXIREDOXIN LIKE* protein gene PXR (At1g48130) from *Arabidopsis thaliana*
p-BnSETL-v1[1234bp]	20638	21871	*SETL*-v1 *Brassica napus* promoter
c-d5Des(Tc_GA2)	21874	23193	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-BnSETL	23215	23828	*SETL*-v1 *Brassica napus* terminator
p-BnFae1	24022	25451	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	25452	26298	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	26306	27208	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	27225	27624	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*

Genetic Elements of plasmid VC-LTM595-1qcz rc	From	To	Description, Function and Source of Element
p-ARC5_perm1	27771	28921	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*
c-d4Des(Tc_GA3)	28932	30491	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	30505	31104	Terminator of *ARC5* gene from *Phaseolus vulgaris*
p-VfUSP_684bp[LLL894]	31183	31866	Promoter from *UNKNOWN SEED PROTEIN* gene USP (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	31867	32118	i-Atss18_252bp functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	32129	33214	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	33223	33438	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-BnFae1	33632	35061	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	35062	35908	i-Atss1_847bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d4Des(Pl_GA)2	35916	37253	*Delta-4 DESATURASE* from *Pavlova lutheri*
t-bnFae1	37270	37669	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-BnSETL-v1[1234bp]	37762	38995	*SETL*-v1 *Brassica napus* promoter
c-o3Des(Pir_GA)	38998	40089	*Omega-3 DESATURASE* from *Pythium irregulare*

Genetic Elements of plasmid VC-LTM595-1qcz rc	From	To	Description, Function and Source of Element
t-BnSETL	40111	40724	*SETL*-v1 *Brassica napus* terminator
p-YPC105906_PcUbi4-2[long]	40848	41824	MTX Parsley (*Petroselinum crispum*) *UBI4-2* promoter with internal intron
c-AtAHASL_A122T_S653N[minusRES]	41832	43844	*ACETOHYDROXYACID SYNTHASE LARGE-SUBUNIT* gene/CDS from *Arabidopsis* with S653N (*csr1-2*) mutation and A122T SDM mutation minus restriction sites
t-AtAHAS-3'UTR[rtp4820]	43845	44624	*Arabidopsis* (dicot) *AtAHASL* 3' Un-uranslated Region [trimmed] terminator for ACETOHYDROXYACID SYNTHASE gene
b-LLB	44848	44713	Left T-DNA Left border from pTi15955 [Genbank #AF242881]
c-KanR_Tn903	46795	45980	Kanamycin Resistance selection gene/CDS
p-Kan[lm500]	46916	46796	Promoter for Kanamycin resistance gene
o-ori-2	48069	48285	ori-2 origin of replication
c-repE	48379	49134	*repE* gene/CDS
c-sopA	49713	50888	*sapA* gene/CDS
c-sopB	50888	51859	*sopB* gene/CDS
c-sopC/incD	51932	52405	*incD*/ *sopC* partial gene/CDS
c-traI	52908	52967	*traI* gene/CDS
mf-traI - repA intergenic region	52956	53318	regulatory region of traR dependent quorum sensing regulon - containing 2 tra-boxes (see LI AND FARRAND JOURNAL OF BACTERIOLOGY,Jan. 2000, p. 179-188)
o-repA	53319	54536	*Rep-A* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY,Jan. 2000, p. 179..188)
rr-repB	54766	55776	*rep-B* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY,Jan. 2000, p. 179..188)

Genetic Elements of plasmid VC-LTM595-1qcz rc	From	To	Description, Function and Source of Element
o-repC	55991	57310	*rep-C* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY,Jan. 2000, p. 179..188)
mf-y4cG	57789	57319	fragment of DNA invertase homolog; similar to *Rhizobium* sp. NGR234 pNGR234a Y4CG
tr-Tn5	59829	58268	Transposon Tn5 sequence
o-oriT	60125	60293	oriT from pRK310 genbank file
b-RB[rtp4394]	148	60913	Right T-DNA Right border

Table 11: Genetic Elements of plasmid VC-LTM593-1qcz rc. Listed are the names of the elements, the position in VC-LTM593-1qcz rc (nucleotide number, note: start position was larger than stop position for elements encoded by the complementary strand of VC-LTM593-1qcz rc), the function and source of the element. The T-DNA integrated into the plant genome during the transformation process was flanked by a right border (nucleotides 59895 to 148 of VC-LTM593-1qcz rc) and a left border (nucleotides 43830 to43695 of VC-LTM593-1qcz rc). Elements outside of that region (=vector backbone) are required for cloning and stable maintenance in *E. coli* and/or agrobacteria.

Genetic Elements of plasmid VC-LTM593-1qcz rc	From	To	Description, Function and Source of Element
p-VfUSP_684bp[LLL894]	329	1012	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	1013	1264	i-Atss18_252bp functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-d6Elo(Pp_GA2)	1267	2139	*Delta-6 ELONGASE* from *Physcomitrella patens*
t-CaMV35S	2140	2355	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-LuCnl(1064bp)	2448	3511	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss14_377bp[LJK32]	3512	3888	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp

Genetic Elements of plasmid VC-LTM593-1qcz rc	From	To	Description, Function and Source of Element
			(numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d5Des(Tc_GA2)	3892	5211	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-AgrOCS 192bp[LED12]	5212	5403	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-SBP	5539	7337	Promoter from a *SUCROSE-BINDING PROTEIN-RELATED* gene from *Vicia faba*
i-Atss2_455bp[LJK20]	7338	7792	i-Atss2_455bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d6Des(Ot_febit)	7802	9172	*Delta-6 DESATURASE* from *Ostreococcus tauri*
t-StCATHD-pA	9200	9434	Terminator from *CATHEPSIN D INHIBITOR* gene [*CATHD*] from *Solanum tuberosum* [Potato]
p-LuPXR 1727bp[LLL823]	9513	11239	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss1_846bp[ltm593]	11240	12085	i-Atss1_847bp functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); 1 bp at poly T stretch shorter compared to original i-Atss1_847bp
c-d6Elo(Tp_GA2)	12099	12917	*Delta-6 ELONGASE* from *Thalassiosira pseudonana*
t-AtPXR 400bp[LLL823]	12973	13372	Terminator from peroxiredoxin like protein gene PXR (At1g48130) from *Arabidopsis thaliana*

Genetic Elements of plasmid VC-LTM593-1qcz rc	From	To	Description, Function and Source of Element
p-Napin A/B	13542	14205	Promoter from *napA/B* gene (napin, seed storage protein) from *Brassica napus*
i-Atss14_377bp[LJK32]	14206	14582	i-Atss14_377bp[LJK32] functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At5g63190, +166 to + 542 bp (numbering relative to start of transcription) (+201 to + 542 bp 5'UTR-Intron only)
c-d12Des(Ps_GA2)	14589	15785	*Delta-12 DESATURASE* from *Phythophthora sojae*
t-E9	15804	16361	Terminator from Small Subunit of RuBisCo *rbcS* gene (*E9*) from *Pisum sativum*
p-BnSETL-v1[1234bp]	16454	17687	*SETL*-v1 *Brassica napus* promoter
c-o3Des(Pir_GA)	17690	18781	*Omega-3 DESATURASE* from *Pythium irregulare*
t-BnSETL	18803	19416	*SETL*-v1 *Brassica napus* terminator
p-VfUSP_684bp[LLL894]	19495	20178	Promoter from *UNKNOWN SEED PROTEIN* gene *USP* (accession: X56240) from *Vicia faba*
i-Atss18_252[LJK36]	20179	20430	i-Atss18_252bp functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At1g01170, + 37 to + 288 bp (numbering relative to start of transcription) (+ 72 to + 282bp 5'UTR-Intron only)
c-o3Des(Pi_GA2)	20441	21526	*Omega-3-DESATURASE* from *Phythophthora infestans*
t-CaMV35S	21535	21750	Terminator CaMV35S from *35S* gene from Cauliflower mosaic virus
p-BnSETL-v1[1234bp]	21886	23119	*SETL*-v1 *Brassica napus* promoter
c-d5Des(Tc_GA2)	23122	24441	*Delta-5 DESATURASE* from *Thraustochytrium* sp. ATCC21685
t-BnSETL	24463	25076	*SETL*-v1 *Brassica napus* terminator
p-ARC5_perm1	25223	26373	Promoter derived from a promoter from *ARCILINE 5* gene from *Phaseolus vulgaris*

Genetic Elements of plasmid VC-LTM593-1qcz rc	From	To	Description, Function and Source of Element
c-d4Des(Tc_GA3)	26384	27943	*Delta-4 DESATURASE* from *Thraustochytrium* sp.
t-pvarc	27957	28556	Terminator of *ARC5* gene from *Phaseolus vulgaris*
p-LuPXR 1727bp[LLL823]	28649	30375	Promoter from *PEROXIREDOXIN LIKE* protein gene *PXR* from *Linum usitatissimum*
i-Atss15_758bp[LJK33]	30376	31133	i-Atss15_758bp[LJK33] functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At2g27040, +93 bp to + 850 bp (numbering relative to start of transcription) (+128 to + 847 bp 5'UTR-Intron only)
c-o3Des(Pir_GA)	31149	32240	*Omega-3 DESATURASE* from *Pythium irregulare*
t-AtPXR 400bp[LLL823]	32297	32696	Terminator from *PEROXIREDOXIN LIKE* protein gene PXR (At1g48130) from *Arabidopsis thaliana*
p-LuCnl(1064bp)	32832	33895	Promoter from *CONLININ* gene from *Linum usitatissimum*
i-Atss2_455bp[LJK20]	33896	34350	i-Atss2_455bp functional intron region; intron with partial 5'UTR, *Arabidopsis thaliana*, Locus At1g65090, +77 to +531bp (numbering relative to start of transcription) (+113 to + 508bp 5'UTR-Intron only)
c-d4Des(Pl_GA)2	34360	35697	*Delta-4 DESATURASE* from *Pavlova lutheri*
t-AgrOCS 192bp[LED12]	35719	35910	Terminator from *OCTOPINE SYNTHASE* gene *OCS* from *Agrobacterium tumefaciens*
p-BnFae1	36104	37533	Promoter from *Beta-KETOACYL-CoA SYNTHASE* (*FAE1.1*) gene from *Brassica napus*
i-Atss1_847bp[LJK19]	37534	38380	i-Atss1_847bp functional intron region; intron with partial 5' UTR, *Arabidopsis thaliana*, Locus At1g62290 (aspartyl protease

Genetic Elements of plasmid VC-LTM593-1qcz rc	From	To	Description, Function and Source of Element
			family protein), +1 to +847bp (numbering relative to start of transcription) (+19 to +841bp 5'UTR-Intron only); from QC1153-1/RTP6393.
c-d5Elo(Ot_GA3)	38388	39290	*Delta-5 ELONGASE* from *Ostreococcus tauri*
t-bnFae1	39307	39706	Terminator from *FATTY ACID ELONGASE* (*FAE1,* At4g34520*)* gene of *Arabidopsis thaliana*
p-YPC105906_PcUbi4-2[long]	39830	40806	MTX Parsley *UBI4-2* promoter with internal intron
c-AtAHASL_A122T_S653N[minusRES]	40814	42826	*ACETOHYDROXYACID SYNTHASE LARGE-SUBUNIT* gene/CDS from *Arabidopsis* with S653N (*csr1-2*) mutation and A122T SDM mutation minus restriction sites
t-AtAHAS-3'UTR[rtp4820]	42827	43606	*Arabidopsis* (dicot) *AtAHASL* 3' Un-translated Region [trimmed] terminator for ACETOHYDROXYACID SYNTHASE gene
b-LLB	43830	43695	Left T-DNA Left border from pTi15955 [Genbank #AF242881]
c-KanR_Tn903	45777	44962	Kanamycin Resistance selection gene/CDS
p-Kan[lm500]	45898	45778	Promoter for Kanamycin resistance gene
o-ori-2	47051	47267	ori-2 origin of replication
c-repE	47361	48116	*repE* gene/CDS
c-sopA	48695	49870	*sapA* gene/CDS
c-sopB	49870	50841	*sopB* gene/CDS
c-sopC/incD	50914	51387	*incD*/ *sopC* partial gene/CDS
c-traI	51890	51949	*traI* gene/CDS
mf-traI - repA intergenic region	51938	52300	regulatory region of traR dependent quorum sensing regulon - containing 2 tra-boxes (see LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179-188)

Genetic Elements of plasmid VC-LTM593-1qcz rc	From	To	Description, Function and Source of Element
o-repA	52301	53518	*Rep-A* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
rr-repB	53748	54758	*rep-B* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY, Jan. 2000, p. 179..188)
o-repC	54973	56292	*rep-C* gene from pTiC58 replicon (LI AND FARRAND JOURNAL OF BACTERIOLOGY,Jan. 2000, p. 179..188)
mf-y4cG	56771	56301	fragment of DNA invertase homolog; similar to *Rhizobium* sp. NGR234 pNGR234a Y4CG
tr-Tn5	58811	57250	Transposon Tn5 sequence
o-oriT	59107	59275	oriT from pRK310 genbank file
b-RB[rtp4394]	148	59895	Right T-DNA Right border

Table 13 compares the order of the gene expression cassettes among all the different constructs and the construct combinations, using short terms for these expression cassettes, see Table 12 for definitions. The data in Examples 10 to 19 demonstrate significant differences among the different construct or construct combinations in terms of the PUFA profile measured in transgenic seed. The differences between constructs and the construct combinations were evident even when eliminating all other sources that affect PUFA levels (e.g. different environments, plant-to-plant variability, seed oil content, T-DNA copy number). For example VC-RTP10690-1qcz_F and VC-LMT593-1qcz rc are isogenic, i.e. the two constructs contained exactly the same gene expression cassettes. Because of the similarity between RTP10690-1qcz_F and VC-LMT593-1qcz one would expect exactly the same pathway step conversion efficiencies e.g. when comparing the average conversion efficiencies of all single copy events. However, Figure 39 shows that VC-RTP10690-1qcz_F had a Delta-4 DESATURASE conversion efficiency of 32%, (average of T1 seeds of 52 single copy T0 events), wheras VC-LMT593-1qcz rc had a Delta-4 DESATURASE conversion efficiency of 47% (average of T1 seeds of 241 single copy T0 events). This was not expected, and can be explained by transcript levels, which in turn determine protein levels. The transcript levels are affected by the genetic elements that flank the *Delta-4 DESATURASE* cassettes in VC-LMT593-1qcz rc. The observations between the two constructs is an unexpected finding and indicates that not only the genome but also the T-DNA itself impacts the Delta-4 DESATURASE conversion efficiency, that was dependent on “gene dosage” as described in Example 19. Furthermore, the data in Example 10 to 19 demonstrate that it was possible to insulate expression cassettes from such effects. As can be seen in those Examples 10-19 all single copy events were capable of producing almost exactly the same VLC-PUFA levels when eliminating all other sources that affect PUFA levels (e.g. different environments, plant-to-plant variability, seed oil content). This was particularly striking when comparing all the single copy events in Example 18. Comparing the total C20+C22 VLC-PUFA content, which was largely controlled by how much was converted by the delta-12 desaturase and by the delta-6 desaturase, it was striking to observe there was virtually no difference between e.g. the single copy event LANPMZ obtained from the contruct combination VC-LJB2197-1qcz + VC-LLM337-1qcz rc, and all single copy events listed in Example 18. To this end, it is important to note that one side of the T-DNA that encodes either the entire pathway (Example 15 to 18) or at least the first steps of the pathway up to ARA and EPA production (Example 10 to 14) always contains the AHAS gene which confers herbicide tolerance but was not involved in the VLC-PUFA pathway. The other side of the T-DNA encodes either the entire pathway (Example 15 to 18) or at least the first steps of the pathway up to ARA and EPA production (Example 10 to 14) in most cases the *Delta-6 ELONGASE* from *Physcomitralla patens* (except in Example 13 and 14). As described in Example 19, the Delta-6 ELONGASE protein encoded by the *Physcomitrella patens* gene works close to maximum conversion efficiency (>90%), thus any increase in delta-6 elongase enzyme levels due to any effect that increases transcript levels will have virtually no effect on the C20 and C22 VLC-PUFA levels. Effectively, the T-DNA determining the total level of VLC-PUFA accumulation are flanked on both sides by genes where expression level differences will have no impact on the VLC-PUFA accumulation. As these two genes were encoded by expression cassettes that were several thousand bp in size, it appears the genes inside the T-DNA were shielded/insulated from any effects the genomic environment could have on the expression level of those genes (e.g. the delta-12-desaturase, compare with Example 19). This effect was consistent with the observation that double copy events differ considerably more in total C20 and C22 VLC-PUFA levels: As in many cases the additional T-DNA insertions are not complete (see Example 10 to 18), resulting in exporsure of T-DNA internal genes to the genome. When these genes are susceptible to gene-dosage effects (the conversion efficiency of those genes depends on the amount of transcript and the derived amount of enzyme, compare with Example 19), then in some genomic locations the genomic environment boosted the transcript level.

Table 12: Definition of shorthands used for plant expression cassettes of this invention

Cassette shorthand	Promoter	Intron	Coding sequence	Terminator
USP/c-d6Elo(Pp_GA2)	p-VfUSP_684bp[LLL894]	i-Atss18_252[LJK36]	c-d6Elo(Pp_GA2)	t-CaMV35S
PXR/c-o3Des(Pir_GA)	p-LuPXR 1727bp[LLL823]	i-Atss15_758bp[LJK33]	c-o3Des(Pir_GA)	t-AtPXR 400bp[LLL823]
Conlinin/c-d5Des(Tc_GA2)	p-LuCnl(1064bp)	i-Atss14_377[LJK32]	c-d5Des(Tc_GA2)	t-AgrOCS 192bp[LED12]
SBP/c-d6Des(Ot_febit)	p-SBP	i-Atss2_455bp[LJK20]	c-d6Des(Ot_febit)	t-StCATHD-pA
PXR/c-d6Elo(Tp_GA2)	p-LuPXR 1727bp[LLL823]	i-Atss1_847bp[LJK19]	c-d6Elo(Tp_GA2)	t-AtPXR 400bp[LLL823]
Fae/c-d6Elo(Tp_GA2)	p-BnFae1	i-Atss1_847bp[LJK19]	c-d6Elo(Tp_GA2)	t-bnFae1
Napin/c-d12Des(Ps_GA)	p-Napin A/B	i-Atss14_377[LJK32]	c-d12Des(Ps_GA)	t-E9
USP/c-o3Des(Pi_GA2)	p-VfUSP_684bp[LLL894]	i-Atss18_252[LJK36]	c-o3Des(Pi_GA2)	t-CaMV35S
UBI/AHAS	p-PcUbi4-2[long]	part of PcUBI promoter	c-AtAHASL_A122T_S653N	t-AtAHAS-3'/UTR[ac321]
Conlinin/d4Des(Eg)	p-LuCnl(1064bp)	N/A	c-d4Des(Eg_GA)	t-AgrOCS 192bp[LED12]
SBP/d15Des(Ch)	p-VfSBP_perm3	N/A	c-d15Des(Ch_ERTp_GA)	t-StCATHD-pA
Conlinin/c-d4Des(Pl_GA)2_var1	p-LuCnl(1064bp)	i-Atss2_455bp[LJK20]	c-d4Des(Pl_GA)2	t-AgrOCS 192bp[LED12]
SETL/c-d5Des(Tc_GA2)	p-BnSETL-v1[1234bp]	N/A	c-d5Des(Tc_GA2)	t-BnSETL
SETL/c-o3Des(Pir_GA)	p-BnSETL-v1[1234bp]	N/A	c-o3Des(Pir_GA)	t-BnSETL
FAE/c-d5Elo(Ot_GA3)	p-BnFAE1	i-Atss1_847bp[LJK19]	c-d5Elo(Ot_GA3)	t-bnFAE1
SETL/c-o3Des(Pir_GA)	p-VfSBP_perm3	N/A	c-o3Des(Pir_GA)	t-StCATHD-pA
ARC/c-d4Des(Tc_GA)_var1	p-ARC5_perm1	N/A	c-d4Des(Tc_GA)	t-pvarc
ARC/c-d4Des(Tc_GA)_var2	p-ARC5_perm1	N/A	c-d4Des(Tc_GA3)	t-pvarc
Conlinin/c-d4Des(Pl_GA)2_var2	p-LuCnl(1064bp)	N/A	c-d4Des(Pl_GA)2	t-AgrOCS 192bp[LED12]
FAE/c-d4Des(Pl_GA)2	p-BnFAE1	i-Atss1_847bp[LJK19]	c-d4Des(Pl_GA)2	t-bnFAE1

Table 13: Order and orientation of plant expression cassettes on T-DNAs. Per column, expression cassettes are abbreviated according to Table 12 and listed from top to bottom in the following way: The top row indicated the right border of the first T-DNA introduced into the plant genome; the following proteins are all listed according to sense orientation of transcription, pointing away from the right border. The end of the first T-DNA was indicated by 'LB'. In case a second T-DNA was used to transfer all pathway genes into the plant genome according to example 7 to 11, the right border of this T-DNA was indicated as 'RB2'. The expression cassettes of the second T-DNA are listed in the following rows. Empty cells have been introduced to facilitate comparison of the different constructs.

VC-LJB2197-1qcz + VC-LLM306-1qcz rc	**VC-LJB2197-1qcz + VC-LLM337-1qcz rc**	**VC-LJB2197-1qcz + VC-LLM338-3qcz rc**	**VC-LJB2755-2qcz + VC-LLM391-2qcz rc**	**VC-LJB2755-2qcz + VC-LLM217-1qcz rc**	**RTP10690-1qcz_F**	**RTP10691-2qcz**	**VC-LMT595-1qcz rc**	**VC-LMT593-1qcz rc**
RB	RB	RB	RB	RB	RB	RB	RB	RB
USP/c-d6Elo(Pp_GA2)	USP/c-d6Elo(Pp_GA2)	USP/c-d6Elo(Pp_GA2)	PXR/c-o3Des(Pir_GA)	PXR/c-o3Des(Pir_GA)	USP/c-d6Elo(Pp_GA2)	USP/c-d6Elo(Pp_GA2)	USP/c-d6Elo(Pp_GA2)	USP/c-d6Elo(Pp_GA2)
Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)	Conlinin/c-d5Des(Tc_GA2)
SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)	SBP/c-d6Des(Ot_febit)
PXR/c-d6Elo(Tp_GA2)	PXR/c-d6Elo(Tp_GA2)	PXR/c-d6Elo(Tp_GA2)	FAE/c-d6Elo(Tp_GA2)	FAE/c-d6Elo(Tp_GA2)	PXR/c-d6Elo(Tp_GA2)	PXR/c-d6Elo(Tp_GA2)	PXR/c-d6Elo(Tp_GA2)	PXR/c-d6Elo(Tp_GA2)
Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)	Napin/c-d12Des(Ps_GA)
			USP/c-o3Des(Pi_GA2)	USP/c-o3Des(Pi_GA2)	PXR/c-o3Des(Pir_GA)	PXR/c-o3Des(Pir_GA)	PXR/c-o3Des(Pir_GA)	
UBI/AHAS	UBI/AHAS	UBI/AHAS	UBI/AHAS	UBI/AHAS				
LB	LB	LB	LB	LB				
RB2	RB2	RB2	RB2	RB2				
Conlinin/d4Des(Eg)	Conlinin/d4Des(Eg)				Conlinin/c-d4Des(Pl_GA)2_var1	SETL/c-d5Des(Tc_GA2)	SETL/c-d5Des(Tc_GA2)	SETL/c-o3Des(Pir_GA)
FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	FAE/c-d5Elo(Ot_GA3)	USP/c-o3Des(Pi_GA2)

VC-LJB2197-1qcz + VC-LLM306-1qcz rc	VC-LJB2197-1qcz + VC-LLM337-1qcz rc	VC-LJB2197-1qcz + VC-LLM338-3qcz rc	VC-LJB2755-2qcz + VC-LLM391-2qcz rc	VC-LJB2755-2qcz + VC-LLM217-1qcz rc	RTP10690-1qcz_F	RTP10691-2qcz	VC-LMT595-1qcz rc	VC-LMT593-1qcz rc
SETL/c-o3Des(Pir_GA)	SETL/c-o3Des(Pir_GA)							SETL/c-d5Des(Tc_GA2)
					ARC/c-d4Des(Tc_GA)_var2	ARC/c-d4Des(Tc_GA)_var2	ARC/c-d4Des(Tc_GA)_var2	ARC/c-d4Des(Tc_GA)_var2
USP/c-o3Des(Pi_GA2)	USP/c-o3Des(Pi_GA2)	USP/c-o3Des(Pi_GA2)			USP/c-o3Des(Pi_GA2)	USP/c-o3Des(Pi_GA2)	USP/c-o3Des(Pi_GA2)	PXR/c-o3Des(Pir_GA)
ARC/c-d4Des(Tc_GA)_var1	ARC/c-d4Des(Tc_GA)_var1	ARC/c-d4Des(Tc_GA)_var1	ARC/c-d4Des(Tc_GA)_var1	ARC/c-d4Des(Tc_GA)_var1	SETL/c-d5Des(Tc_GA2)			Conlinin/c-d4Des(Pl_GA)2_var1
		Conlinin/d4Des(Eg)	Conlinin/d4Des(Eg)	Conlinin/c-d4Des(Pl_GA)2_var2		FAE/c-d4Des(Pl_GA)2	FAE/c-d4Des(Pl_GA)2	FAE/c-d5Elo(Ot_GA3)
					SETL/c-o3Des(Pir_GA)	SETL/c-o3Des(Pir_GA)	SETL/c-o3Des(Pir_GA)	
					UBI/AHAS	UBI/AHAS	UBI/AHAS	UBI/AHAS
LB2	LB2	LB2	LB2	LB2	LB	LB	LB	LB

Example 5: Procedure for production of transgenic plants using a Co-Transformation approach

In general, the transgenic rapeseed plants were generated by a modified protocol according to DeBlock et al. 1989, Plant Physiology, 91:694-701). For the generation of rapeseed plants transgenic for two different T-DNAs, the binary vectors described in example 3 were transformed into *Agrobacterium rhizogenes* SHA001 (see WO2006024509 A2 for full description of the *Agrobacterium* used). For the transformation of rapeseed plants (cv. Kumily), a co-transformation strategy was used. Transformation was performed with two different agrobacteria strains harbouring one of the two different plasmids listed in Table 14 and described in detail in Example 3, Example 4, Example 6 and/or Example 7

Table 14: Overview of combinations used in Co-transformation Strategy described in Example 3 for generation of plants harboring two different T-DNAs

ID of Combination	Plasmid containing **T-DNA 1** harbored by *Agrobacterium tumefaciens* **clone 1**		Plasmid containing **T-DNA 2** harbored by *Agrobacterium tumefaciens* **clone 2**	
	Plasmid name	Selectable marker for transgenic plants	Plasmid name	Selectable marker for transgenic plants
A	VC-LJB2197-1qcz	AHAS	VC-LLM306-1qcz rc	None
B	VC-LJB2197-1qcz	AHAS	VC-LLM337-1qcz rc	None
C	VC-LJB2197-1qcz	AHAS	VC-LLM338-3qcz rc	None
D	VC-LJB2755-2qcz rc	AHAS	VC-LLM391-2qcz rc	None
E	VC-LJB2755-2qcz rc	AHAS	VC-LTM217-1qcz rc	None

Overnight cultures of the two strains intended to be co-transformed were prepared in YEB medium with antibiotics (20 mg/L chloramphenicol, 5 mg/L tetracycline, 25 mg/L Spectinomycin) and grown at 28°C. On the next day the optical density of the culture was checked at 600 nm wave length. It reached about 1.0. Cultures of lower optical density were extended in cultivation period. Cultures with an optical density of above 1.3 were diluted with YEB medium to an OD of approximately 0.2 and cultured until they reached an OD of 1.0.
Cultures were pelleted at about 4000 g and re-suspended in liquid MS medium (Murashige and Skoog 1962), pH 5.8, 3% sucrose with 100 mg/L Acetosyringone to reach an OD_{600nm} of 0.1.
The *Agrobacterium* suspensions corresponding to each of the two constructs to be co-transformed were mixed in equal parts and used for inoculation of hypocotyl segments prepared from 5 days old etiolated seedlings.

Seeds were germinated under low light conditions (< 50 µMol/m2s) using MSB5 medium from Duchefa (Duchefa Biochemie, PO Box 809 2003 RV Haarlem, Netherlands), pH 5.8, 3% sucrose and 0.8% Oxoid agar. Germination under light conditions produces explants, which are more stable and easier to handle compared to etiolated hypocotyls. Hypocotyl segments of 4 to 7 mm length were inoculated in a bath of Agrobacterium cells under gentle shaking up to 4 min, followed by sieving the explants. Infected explants were transferred to petri dishes with co-cultivation medium (MS medium, pH 5.6, 3% sucrose, 0.6 g/L MES (2-(N-Morpholino)ethanesulfonic acid), 18 g/L mannitol, 0.7% phytoagar (Duchefa Biochemie, PO Box 809 2003 RV Haarlem, Netherlands, part number SKU:P1003), 100 mg/L Acetosyringone, 200 mg/L L-Cysteine, 1 mg/L 2,4D (2,4-Dichlorophenoxyacetic acid)) carrying one layer of Whatman filter paper on its surface. Petri dishes were sealed with tape and incubated at 23 C under long day conditions (16 h light/8 h darkness) for three days. After the three days co-cultivation period explants were transferred to MS medium, pH 5.6, 3% sucrose, 0.6 g/L MES, 18 g/L mannitol, 07% Phytoagar, 1 mg/L 2,4D and 500 mg/L Carbenicillin to prevent *Agrobacterium* growth and incubated for a recovery period under the same physical conditions as for the co-cultivation for 7 days.
For selective regeneration explants were transferred after the recovery period to MS medium, pH 5.8, 3% sucrose, 0.7% Phytoagar, 2.5 mg/L $AgNO_3$, 3 mg/L BAP (6-Benzylaminopurine), 0.1 mg/L GA (Gibberellic acid), 0.1 mg/L NAA (1-Naphthaleneacetic acid), 500 mg/L Carbenicillin, 100 nM Imazethapyr (Pursuit) and cultured for two weeks under long day conditions as described above. Sub-cultivation takes place every two weeks. Hormones were stepwise reduced as follows: BAP 3 to 0.5 to 0.05 mg/L; GA (Gibberellic acid) 0.1 to 0.25 to 0.25 mg/L; NAA 0.1 to 0 to 0 mg/L.
Developing shootlets could be harvested after the second cycle of selective regeneration. Shootlets were cut and transferred to either Elongation/rooting medium (MS medium, pH 5.8, 2%sucrose, 100 mg/L myo-inositol, 40 mg/L Adenine sulphate, 500 mg/L MES, 0.4% Sigma Agar, 150 mg/L Timentin, 0.1 mg/L IBA (Indole-3-butyric acid)) or to rock wool/stone wool or foam mats (Grodan, GRODAN Group P.O. Box 1160, 6040 KD Roermond The Netherlands, or Oasis, 919 Marvin Street, Kent, OH 44240 USA) watered with 1/10 Vol. of MS medium, pH 5.8 without sucrose under ex vitro long day conditions in covered boxes.

Shoots were elongated and rooted in *in vitro* medium and were transferred directly to soil.

Either in vitro shoots or GH adapted shoots were sampled for molecular analysis.

Medium were used either autoclaved (except antibiotics, hormones, additives such as L-cysteine, Acetosyringon, imidazolinone components) or filter sterilized prepared (Agar component autoclaved, allowed to cool to 42 C and then used).

Example 6: Procedure for production of transgenic plants using BiBACs

For BiBAC transformation the same protocol as described for the co-transformation approach was used except that only one construct was used. According to the prokaryotic kanamycin resistance gene of binary plasmid 50 mg/L kanamycin was used instead of Spectinomycin for *Agrobacterium* growth. It was observed during the course of this work that *Agrobacterium* carrying BiBACs grow very slowly, often taking 18 hours to reach a liquid culture OD_{600nm} considered optimal for use in plant transformation.

The table below gives an example for some key data documented during the transformation of the construct LTM593

	VC-LTM593-1qcz rc
Explants inoculated	37 600
Shoots harvested	2 630
Shoots sampled and analyzed for gene AHAS	1 543
Transgenic events with gene AHAS	1 050
Transformation efficiency (%)	2.8
Percentage of events that grown on herbicide seelction plates but where confirmed using qPCR to lack the herbiced resitstance marker (%)	32.0

The amount of single copy events produced by the plant transformation protocol described above was 45% and 38% of vector backbone-free events selected after transformation of the constructs LTM593 and LTM595, respectively, were single copy events (see Table 15).

Table 15: Statistics of single and double copy events with and without vector backbone in transformation experiments performed with the two BiBAC strains VC-LTM593-1qcz rc and VC-LTM595-1qcz rc

	VC-LTM593-1qcz rc		VC-LTM595-1qcz rc	
	#	%	#	%
Number of transgenic events confirmed to contain at least 1 copy of gene c-AtAHAS	1050		217	
Single copy	535	50	92	42
Single copy, vector backbone-free	478	45	83	38
Double copy	320	30	49	23
Double copy vector backbone-free	227	22	41	18

One important key finding for successful transformation was the choice of *Agrobacterium* strain. While the original method (see De Block et al. (1989) Plant Physiology 91:694-701) used the *Agrobacterium tumefaciens* strain C58C1pMP90, the described method was based on the *Agrobacterium rhizogenes* strain SHA001 (see WO2006024509 A2 for SHA001 and SHA017).

Even within *Agrobacterium rhizogenes* strains we have realized a clear response of transformation success to the strain and construct used (seeTable 16).

Table 16: Impact of Agrobacterium rhizogenes strains on transformation success of BiBACs

	VC-RTP10690-1qcz_f	VC-LTM593-1qcz rc
Strain used	**SHA017**	**SHA001**
Number of inoculated explants	60700	37600
Regeneration efficiency (%)	1.8	4.1
Shoots sampled and analysed for gene AHAS	1084	1543
Number of transgenic plants based on the presence of gene c-AHAS	333	1050
Transformation efficiency (TE) (%)	0.6	2.8
Percentage of events that grown on herbicide seelction plates but where confirmed using qPCR to lack the herbiced resitstance marker (%)	69.3	32.0

Table 17: Transformation Efficiencies of the various plasmids and Agrobacterium strains used. With respect to the integration of the T-DNA, it was possible that multiple copies or single copies of intact or truncated or duplicated T-DNA's could be inserted into the genome. The terms copy or copies refer to the number of copies of a particular T-DNA or fragment of a T-DNA that were inserted into the plant genome. The term locus refers to how many different locations within the plant genome the copy or copies of the T-DNA were inserted into and isdefined as a region of disequilibrium within the genome and which can vary between plant species and even within cultivars of a given species. For the purpose of this definition this is within one genetic map unit or CentiMorgan.

Outcome	**VC-LJB2197-1qcz + VC-LLM337-1qcz rc**	**VC-LJB2755-2qcz rc + VC-LLM391-2qcz rc**	**VC-RTP10690-1qcz_f**	**VC-LTM593-1qcz rc**
Agrobacterium strain	SHA001	SHA001	SHA017	SHA001
Transformation efficiency (TE) (%) based on the presence of gene AHAS	17	19.7	0.6	2.8
Percentage of events that grown on herbicide seelction plates but where confirmed using qPCR to lack the herbiced resitstance marker (%)	1.1	0.6	69.3	32.0

Outcome	VC-LJB2197-1qcz + VC-LLM337-1qcz rc	VC-LJB2755-2qcz rc + VC-LLM391-2qcz rc	VC-RTP10690-1qcz_f	VC-LTM593-1qcz rc
Genes of both T-DNAs present (% co-transformed)	11.2	15.1	n. a.	n. a.
% of single copy events **one locus integration**	0	0	100	100
Portion of selected “more copy events” (2 to 3 copies) with **one locus integration**	0	0	n.d.	25 from 33

Example 7: Seed Germination and Plant Growth in the Greenhouse and Field

Transformed plants were cultivated for seed production and phenotypic assessment in both the greenhouse and in the field. Greenhouse growth conditions were a sixteen hour light period followed by an eight hour dark period. The temperature was 20 degrees celsius during the light period (also called the day period) with a level of light corresponding to 200-300 micromoles of photons m-2 s-1 (this is the incident of light at the top of the plant and lights were adjusted in terms of distance from the plant to achieve this rate). During the day period the range of light in the greenhouse varied between 130 and 500 micromoles of photons m-2 s-1. Getting out of the day range just cited triggered either the use of artificial light to bring the level up to 200-300 micromoles of photons m-2 s-1 or shading and/or shut off of lights to bring the level back to 200-300 micromoles of photons m-2 s-1. The dark period (also referred to as the night period) temperature was 18 C. Four hours before the light period began the temperature was lowered to 15 C for the remainder of the dark period. Plants were irrigated and treated for insects as necessary. The soil type was 50 % Floradur B Seed + 50 % Floradur B Cutting (including sand and perlite) provided by Floragard (Oldenburg, Germany). Plant growth was enhanced by nutrient supplementation. Nutrients were combined with the daily watering. A 0.1% (w/v) fertilizer solution (Hakaphos Blue 15(N) -10 (P) - 15(K), Compo GmbH & Co KG, Münster, Germany) was used to water the plants. Water was supplied on demand (e.g. depending on plant growth stage, water consumption etc.). To avoid cross-pollination, plants were bagged at the time when the first flowers opened. Plants were checked daily in order to ensure that all open flowers were covered by the bags. Open flowers that were not covered properly were removed.

For field grown plants, the plants were grown in six locations which correspond climatically to USDA growth zones 3a-4b and 5a, and five locations corresponding climatically to USDA growth zones 8a-9b and 11. The plants grown in the regions corresponding to USDA growth zones 3a-4b and 5a were grown in the summer and the plants grown in the regions corresponding to USDA growth zones 8a-9b and 11 were grown in the winter. Standard horticultural practices for canola were followed. Netting and other measures to protect from birds and insects were used as deemed necessary by the growers, as were herbicides and fertilizer applications. The planting density for all locations was eighty seeds per square meter with germination rate of 95 or better percent.

In the case where it was necessary to determine germination rates for the purpose of seed quality assurance or control, or where it was advantageous to germinate seeds to obtain cotyledons or seedling tissues, the following protocol was used:
150 mm by 15 mm petri-plates and Whatman (no. 2) filter paper cut into 120 mm disks were used. The filter paper was pre-moistened with sterile deionized water. One hundred seeds of the appropriate line were obtained and spread evenly across the pre-moistened filter paper.

Clean and sterile tweezers were used to spread the seeds to obtain the uniform pattern as shown above. Additional sterile water was added to ensure the seeds and paper were wetted, but not floating. The total amount of water used per petri-plate was approximately 20 mL. Three plates were done for each genotype tested. The plates were sealed with surgical tape, VWR (1050 Satellite Blvd.Suwanee, GA 30024 USA) catalog number 56222-110. After the plates were sealed, they were then incubated in a germination chamber set to 90% humidity, set to a sixteen hour photoperiod with 20 degrees Celsius day temperature and 15 degrees Celsius night temperature. The light intensity was 90-120 micro-moles per square meter per second. Germination was scored twice, once at four days after placing the plates into the growth chamber and again at eight days after incubation.

Example 8: Lipid extraction and lipid analysis of plant oils

The results of genetic modifications in plants or on the production of a desired molecule, e.g. a certain fatty acid, were determined by growing the plant under suitable conditions, e.g. as described above and analyzing the growth media and/or the cellular components for enhanced production of the desired molecule, e.g. lipids or a certain fatty acid. Lipids were extracted as described in the standard literature including Ullman, Encyclopedia of Industrial Chemistry, Bd. A2, S. 89-90 und S. 443-613, VCH: Weinheim (1985); Fallon, A., et al., (1987) “Applications of HPLC in Biochemistry“ in: Laboratory Techniques in Biochemistry and Molecular Biology, Bd. 17; Rehm et al. (1993) Biotechnology, Bd. 3, Kapitel III: “Product recovery and purification“, S. 469-714, VCH: Weinheim; Belter, P.A., et al. (1988) Bioseparations: downstream processing for Biotechnology, John Wiley and Sons; Kennedy, J.F., und Cabral, J.M.S. (1992) Recovery processes for biological Materials, John Wiley and Sons; Shaeiwitz, J.A., und Henry, J.D. (1988) Biochemical Separations, in: Ullmann’s Encyclopedia of Industrial Chemistry, Bd. B3; Kapitel 11, S. 1-27, VCH: Weinheim; and Dechow, F.J. (1989) Separation and purification techniques in biotechnology, Noyes Publications.

It is acknowledged that extraction of lipids and fatty acids can be carried out using other protocols than those cited above, such as described in Cahoon et al. (1999) Proc. Natl. Acad. Sci. USA 96 (22):12935-12940, and Browse et al. (1986) Analytic Biochemistry 152:141-145. The protocols used for quantitative and qualitative analysis of lipids or fatty acids are described in Christie, William W., Advances in Lipid Methodology, Ayr/Scotland: Oily Press (Oily Press Lipid Library;

2); Christie, William W., Gas Chromatography and Lipids. A Practical Guide - Ayr, Scotland: Oily Press, 1989, Repr. 1992, IX, 307 S. (Oily Press Lipid Library; 1); “Progress in Lipid Research, Oxford: Pergamon Press, 1 (1952) - 16 (1977) u.d.T.: Progress in the Chemistry of Fats and Other Lipids CODEN.

To generate transgenic plants containing the genetic elements described in examples 3 and 4 for production of EPA and DHA in seeds, rapeseed (*Brassica napus*) was transformed as described in examples 5 and 6. Selected plants containing the genetic elements described in examples 3 and 4 were grown until development of mature seeds under the conditions cited in Example 7. Fatty acids from harvested seeds were extracted as described above and analyzed using gas chromatography as described above. The content (levels) of fatty acids is expressed throughout the present invention as percentage (weight of a particular fatty acid) of the (total weight of all fatty acids). Similiarly, the contents of other component of the oil are given in “% w/w”. E.g., the content (levels) of TAGs or PCs is expressed throughout the present invention as percentage (weight of a particular TAGs or PCs) of the (total weight of all TAGs or PCs), in particular ot the total weight off all TAGs or PCs present in the oil or lipid of the present invention. In an embodiment, the contents of the compounds are determined as described in the Examples. For example, the contents can be determined as in Examples 29, 31 or 32. Seed oil content is expressed throughout the present invention as percentage of (oil weight) of the (total weight of seeds).

Table 18: Fatty acids analyzed using gas chromatography

Systematic name	Trivial Name	Short hand 1	Short hand 2
Hexadecanoic acid	Palmitic acid	16:0	
(Z)-7-Hexadecenoic acid		16:1n-9	
(Z,Z,Z)-7,10,13-Hexadecatrienoic acid		16:3n-3	
Octadecanoic acid	Stearic acid	18:0	
(Z)-9-Octadecenoic acid	Oleic acid	18:1n-9	OA
(Z,Z)-9,12-Octadecadienoic acid	Linoleic acid	18:2n-6	LA
(Z,Z)-6,9-Octadecadienoic acid		18:2n-9	
(Z,Z,Z)-9,12,15-Octadecatrienoic acid	alpha-Linolenic acid	18:3n-3	ALA
(Z,Z,Z)-6,9,12-Octadecatrienoic acid	gamma-Linolenic acid	18:3n-6	GLA
(Z,Z,Z,Z)-6,9,12,15-Octadecatetraenoic acid	Stearidonic acid	18:4n-3	SDA
Eicosanoic acid	Arachidic acid	20:0	
(Z)-11-Eicosenoic acid	Gondoic acid	20:1n-9	
(Z,Z)-11,14-Eicosadienoic acid		20:2n-6	
(Z,Z,Z)-11,14,17-Eicosatrienoic acid		20:3n-3	
(Z,Z,Z)-8,11,14-Eicosatrienoic acid	Dihomo-gamma-linolenic acid	20:3n-6	DHGLA
(Z,Z,Z)-5,8,11-Eicosatrienoic acid	Mead acid	20:3n-9	
(Z,Z,Z,Z)-8,11,14,17-Eicosatetraenoic acid		20:4n-3	ETA
(Z,Z,Z,Z)-5,8,11,14-Eicosatetraenoic acid	Arachidonic acid	20:4n-6	ARA
(Z,Z,Z,Z,Z)-5,8,11,14,17-Eicosapentaenoic acid	Timnodonic acid	20:5n-3	EPA
Docosanoic acid	Behenic acid	22:0	
(Z)-13-Docosenoic acid	Erucic acid	22:1n-9	
(Z,Z,Z,Z)-7,10,13,16-Docosatetraenoic acid	Adrenic acid	22:4n-6	DTA
(Z,Z,Z,Z,Z)-7,10,13,16,19-Docosapentaenoic acid	Clupanodonic acid	22:5n-3	DPAn-3
(Z,Z,Z,Z,Z)-4,7,10,13,16-Docosapentaenoic acid	Osbond acid	22:5n-6	DPAn-6
(Z,Z,Z,Z,Z,Z)-4,7,10,13,16,19-Docosahexaenoic acid		22:6n-3	DHA

Example 9: Non-destructive analysis of lipids in single cotyledons of seedlings

Transformation of plants according to the methods described in Example 5 and Example 6 results in a random integration of the T-DNA into the genome. It was known that such integrations can also occur in a partial manner, furthermore multiple integrations of complete and partial T-DNAs can occur. Self pollination of the T0 plant will result in production of T1 seeds which will be segregating for the T-DNA insertion(s) according to the ratios observed by Gregor Mendel (Mendel, 1866) and which are now part of the basic general knowledge in the life sciences. Due to the Mendelian segregation; for each integration of the T-DNA, one quarter (~25%) of the T1 seed have lost the integration, and can be called “null segregants”. 50% of the T1 seed will carry the T-DNA integration either on the maternal chromosome (25%), or paternal chromosome (25%); these seeds are ‘heterozygous’ or ‘hemizygous’ related to the T-DNA integration. The remaining quarter (~25%) of the T1 seed will carry the T-DNA on the maternal and paternal chromosome; these seeds are ‘homozygous’ related to the T-DNA integration. For plants that follow such a sexual propagation, it is essential to genetically fix the T-DNA integration(s), by selecting progenies that are homozygous for the T-DNA integration(s).

In order to identify T1 seedlings where each T-DNA integration that was essential for the trait was present, ideally homozygous, one can perform quantitative PCR to measure the copy number of the T-DNA integration(s) directly. Alternatively one can analyse the trait conferred by the presence of the T-DNAs, which at least enables the identification of all seeds that do not contain all T-DNA of interest (null-segregants). For all constructs described in Example 10 to Example 14, and where indicated, a non-destructive analysis of VLC-PUFA production was performed. To this end, T1 seeds were germinated in the dark for three days on wet filter paper. After three days, one of the two cotyledons was cut off to subject it to lipid analysis as described in Example 8. The other cotyledon, including the hypocotyl and root, was planted in soil. As an example, the result from the lipid content analysis of these cotyledons from segregating T1 seedlings of event LANPMZ obtained from the construct combination described in Example 11 are shown in Figure 22; the results of event LBDIHN obtained from the construct combination described in Example 15 are shown in Figure 23. In both of these figures, it is observed that one quarter of the seed do not produce a significant amount of VLC-PUFA, while producing wildtype levels of Oleic acid (null segregant seedlings). One can furthermore see in both figures two additional clusters of seedlings that produce different amounts of VLC-PUFA, see Figure 23. Counting the number of seed in these respective clusters, a 1:2:1 segregation ratio was observed for the clusters that produce (~0 VLC-PUFA): (intermediate level of VLC-PUFAs): (higher level of VLC-PUFAs). The observations demonstrate a relationship between ‘gene dosage’, that was the number of T-DNA copies present in the genome, and VLC-PUFA levels. For all constructs described in Example 10 to Example 13, and where indicated, this relationship was exploited to identify T1 plants where at least one T-DNA locus has become homozygous, or where multiple T-DNA integration loci are at least present, or some are homozygous while others still segregate. The applicability of this method can be demonstrated for event LANPMZ, see Figure 22, all heterozygous (hemizygous) and homozygous T1 seeds of event LANPMZ that produce VLC_PUFA are capable of producing both EPA and DHA. As DHA production requires the presence of both T-DNAs, it can be concluded that at least one copy of the T-DNA of VC-LJB2197-1qcz and one copy of the T-DNA of VC-LLM337-1qcz rc have inserted into the genome, likely at the same locus. 13 T1 seedlings of those 288 seedlings of event LANPMZ having the highest VLC-PUFA levels have been selected and have been grown to mature plants. Copy number analysis on those 13 selected plants shown in Table 40 indicates that both T-DNAs are present in a single copy, and comparison of the T0 plant copy number results against the average result of the 13 T1 plants demonstrates that these single T-DNA insertions are homozygous (duplicated copy number). All results combined provide the information that the event LANPMZ contains the T-DNAs of construct VC-LJB2197-1qcz and the T-DNA of construct VC-LLM337-1qcz rc in one copy each, whereby both T-DNAs co-segregate in a single locus.

For a single T-DNA integration into the genome, 1 out of 4 T1 seed are expected to be homozygous for that T-DNA integration. For each additional T-DNA integration, just one quarter of all seed homozygous for all other T-DNA integrations are homozygous for the additional T-DNA integration, consequently for two T-DNA integration events into the genome 1 out of 16 T1 seed are expected to be homozygous for both T-DNA integration; for three T-DNA integration into the genome 1 out of 64 T1 seed are expected to be homozygous for all three T-DNA integration;

for four T-DNA integration into the genome 1 out of 256 T1 seed are expected to be homozygous for all four T-DNA integration; and so forth. All plants in Example 10 to Example 14 contain a minimum of two T-DNA insertion events (one from each plasmid) in order for the plant to contain all the necessary genes to generate all the required enzymes to reconstitute the PUFA pathway sufficiently to generate the VLC-PUFAs: DHA and EPA as well as ARA.

Example 10: Plants containing the T-DNAs of plasmid VC-LJB2197-1qcz and VC-LLM306-1qcz rc (combination A in example 5) for production of EPA and DHA in seeds

In this example, the genetic elements required for EPA and DHA synthesis were transferred into the plant genome on two different T-DNAs. To this end, the two different plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc containing two different T-DNAs where cloned into agrobacteria, and plant tissue was incubated according Example 5 at the same time with these two agrobacterial cultures that are identical apart from containing either VC-LJB2197-1qcz or VC-LLM306-1qcz rc. Due to the selectable herbicide resistance marker, regenerated plants contained at least the T-DNA of VC-LJB2197-1qcz. Only those plants were kept, that also contained the T-DNA of plasmid VC-LLM306-1qcz rc as confirmed by PCR, conducted as described in Example 24, which contains a description of PCR used for gene expression and gene copy number determination. Only plants containing both the T-DNA of plasmid VC-LJB2197-1qcz as well as the T-DNA of plasmid VC-LLM306-1qcz rc contain all the genetic elements required for EPA and DHA synthesis in seeds. The genetic elements of VC-LJB2197-1qcz, and the function of each of the elements, are listed in Table 1. The genetic elements of VC-LLM306-1qcz rc, and the function of each of the elements, are listed in Table 3. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LJB2197-1qcz and VC-LLM306-1qcz rc that are required for EPA and DHA synthesis are additionally listed in Table 19.

Table 19: Combined list of useful genes of EPA and DHA synthesis carried by the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc.

Genes encoding enzymes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA)	VC-LJB2197-1qcz	1196	Delta-12 desaturase from *Phythophthora sojae*
c-d6Des(Ot_febit)	VC-LJB2197-1qcz	1370	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Des(Ot_febit)	VC-LLM306-1qcz rc	1370	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Pp_GA2)	VC-LJB2197-1qcz	872	Delta-6 elongase from *Physcomitrella patens*
c-d6Elo(Tp_GA2)	VC-LJB2197-1qcz	818	Delta-6 elongase from *Thalassiosira pseudonana*

Genes encoding enzymes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length (bp)	Enzymatic function and source of encoded protein
c-d5Des(Tc_GA2)	VC-LJB2197-1qcz	1319	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	VC-LLM306-1qcz rc	1085	Omega-3-desaturase from *Phythophthora infestans*
c-o3Des(Pir_GA)	VC-LLM306-1qcz rc	1091	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	VC-LLM306-1qcz rc	902	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Eg_GA)	VC-LLM338-3qcz rc	1625	Delta-4 desaturase from *Euglena gracilis*
c-d4Des(Tc_GA)	VC-LLM306-1qcz rc	1559	Delta-4 desaturase from *Thraustochytrium* sp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc cultivated in greenhouses during the summer.

The data in Table 20, Table 21 and Table 22 show that there was an increase in DHA and EPA content when comparing one versus two copies of each of the T-DNAs (VC-LJB2197-1qcz and VC-LLM306-1qcz rc) in the plant. The copy number of the construct VC-LJB2197-1qcz has been determined by measuring the left border of the T-DNA in the T0 generation and not other genetic elements along the T-DNA (see Table 20). It was possible that the 88 plants representing the single copy category do in fact contain additional partial T-DNA insertions, and that the 86 plant representing the double copy category might in fact lack parts of one of the T-DNAs. Therefore, due to insufficient data to correctly classify T0 plants into “single copy” and “double copy” groups, both populations overlap. Comparisons between two and three copies of the T-DNA’s revealed that there was a minimal increase in DHA and EPA, suggesting that two copies of each gene was sufficient to reach maximum performance of the VLC-PUFA biosynthesis pathway (C20 and C22 PUFAs, including, but not limited to, EPA, DHA and ARA) when considering copy numbers up to three. Of note was that the majority of insertions in this example are one or two copy events. Table 23 indicates that with respect to the PUFA pathway or the copy number of the T-DNA encoding genes of the PUFA pathway, there was no significant effect on plant morphology or development when the plant carries one, two or three copies of the T-DNA’s of interest.

Table 20: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49, tc: all T0 plants where the average of all copy number assays listed in this table was 2.51-3.49.

	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Des(Ot_febit) near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LLM306-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-p-BnFAE_ t-PvARC located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border.						
Event	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	c-d6Des(Ot_febit)	j-t-CaMV_p-LuCnl-2	j-i-Atss18_c-d6Elo(Pp_GA2)	c-d6Des(Ot_febit)	j-p-BnFAE_t-PvARC	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
sc (n=88)	1.2										1.1	1.2		1.1
dc (n=86)	1.6										1.8	2.4		1.7
tc (n=5)	1.9										3.4	4.2		3.2

Table 21: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 20. The number of T1 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1n-7	16:3n-3	18:0	18:1n-9	18:2n-6	18:2n-9	18:3n-3	18:3n-6	18:4n-3	20:0	20:1n-9	20:2n-6	20:3n-3	20:3n-6	20:4n-3	20:4n-6	20:5n-3	22:0	22:1n-9	22:4n-6	22:5n-3	22:5n-6	22:6n-3	22:4n-3	20:2n-9
sc (n=88)	4.9 ± 0.9	0.3 ± 0.1	0.1 ± 0	2.9 ± 0.6	39.3 ± 8.2	28.4 ± 5.8	0.7 ± 4.4	5.8 ± 1.3	0.4 ± 0.6	0.1 ± 0.2	0.8 ± 0.1	0.9 ± 0.2	0.9 ± 0.6	0.3 ± 0.3	1.6 ± 0.8	0.9 ± 0.6	2.2 ± 1.7	3.3 ± 1.4	0.3 ± 0.1	0 ± 0	0.3 ± 0.3	1.3 ± 0.7	0 ± 0	0.5 ± 0.3	0.2 ± 0.3	
dc (n=86)	4.8 ± 1	0.3 ± 0.1	0.1 ± 0	3 ± 0.7	37.9 ± 9.2	27.9 ± 6.4	1.1 ± 5.7	5.8 ± 1.4	0.7 ± 0.7	0.1 ± 0.1	0.8 ± 0.2	0.9 ± 0.2	0.8 ± 0.6	0.3 ± 0.3	1.6 ± 1	1 ± 0.5	2 ± 1.6	4 ± 2.1	0.3 ± 0.1	0 ± 0	0.6 ± 0.4	1.8 ± 0.9	0 ± 0	0.8 ± 0.5	0.4 ± 0.3	
tc (n=5)	5 ± 0.9	0.3 ± 0.1	0.1 ± 0	3.1 ± 0.7	39.1 ± 8.1	28.4 ± 4.5	0.5 ± 0.3	6.1 ± 1.5	0.9 ± 0.6	0.2 ± 0.1	0.8 ± 0.2	0.9 ± 0.2	0.7 ± 0.6	0.3 ± 0.2	2.1 ± 2.1	1.2 ± 1	1.9 ± 2.4	4 ± 2.9	0.3 ± 0.1	0 ± 0	0.7 ± 0.4	1.9 ± 1.1	0 ± 0	0.8 ± 0.5	0.8 ± 0.9	

Table 22: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been

grouped into the categories indicated in the first column as described in Table 20. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	4.9	0.2	0.0	3.5	23.1	34.2	0.2	5.4	0.4	0.2	0.8	0.9	2.5	1.1	3.0	2.4	3.5	13.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	
dc (n=1)	7.1	0.0	0.0	4.5	3.2	44.5	1.5	0.3	0.0	0.0	1.0	1.1	2.3	0.5	9.8	1.8	0.0	12.6	0.4	0.0	1.3	4.9	0.0	2.8	0.6	
tc (n=1)	3.4	0.1	0.0	2.8	29.4	27.4	0.6	6.6	1.0	0.3	0.7	0.9	1.1	0.5	1.5	1.6	2.6	10.4	0.3	0.0	1.1	5.1	0.0	1.9	0.5	

Table 23: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events were grouped into the categories indicated in the first column as described in Table 20. The number of T1 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
sc (n=88)	68.6 ± 9.2	1 ± 0	1.5 ± 1.4	2.2 ± 1.7	3.1 ± 3.1	3 ± 0	3 ± 0	5 ± 0	3.3 ± 2.5	3.8 ± 0.6	115.9 ± 12.6	3.6 ± 0.4	4.1 ± 1.9
dc (n=86)	69.4 ± 8.8	1 ± 0	1.5 ± 1.1	2.2 ± 1.5	2.9 ± 2.7	3 ± 0	3 ± 0.2	5 ± 0	2.9 ± 2.3	3.8 ± 0.6	115.8 ± 10.2	3.7 ± 0.4	4.5 ± 1.8
tc (n=5)	72.2 ± 8.2	1 ± 0	1 ± 0	1.6 ± 1.3	2.4 ± 0.9	3 ± 0	3 ± 0	5 ± 0	2.4 ± 1.5	4 ± 0	117 ± 9.7	4 ± 0.5	4 ± 0.8

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc cultivated in greenhouses during winter

The copy number analysis indicates that LALTHK was homozygous for two copies of the VC-LJB2197-1qcz T-DNA and homozygous for one copy of the VC-LLM306-1qcz rc while LALJCX was homozygous for two copies of both T-DNAs (VC-LJB2197-1qcz and VC-LLM306-1qcz rc). The other events were still partially segregating for the T-DNAs but contained at least one copy of each T-DNA in all plants. Event LALTHK had no accumulation of DHA, which illustrates the effects of truncations which can occur during insertion of the T-DNA. The events, with the exception of LALTHK, are, within error, similar to one another in terms of EPA+DHA accumulation. The similarity in copy numbers of the events, see Table 23, indicates that insertion site effects that could enhance or repress gene expression are impacting all events equally. The lack of significant variation in EPA and DHA accumulation suggests that there may be a buffering effect in the construct design, such that the T-DNA's integrate into the genome in a manner that minimizes positional effects in gene expression in the T-DNA. The event with the highest VLC-PUFA accumulation, in particular EPA and DHA, was LALFWA which had a maximum accumulation of 4.2 percent DHA and 16 percent EPA with respect to total fatty acid content in the mature seed, but on the average was similar to the other events.

Table 24: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. The T1 plants underwent a selection from 250 segregating T1 seedlings using half-kernel analysis, where the correlation of VLC-PUFA levels with copy number was employed to select for homozygous plants, or on case of multilocus events to selecect for plants where one or more loci are homozygous. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth. Odd results of 3 and 5 indicate that at least some of the selected T1 plants carry a heterozygous locus.

	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Des(Ot_febit) near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.							Copy number assays targeting the T-DNA of VC-LLM306-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-p-BnFAE_ t-PvARC located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.						
Event	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	c-d6Des(Ot_febit)	j-t-CaMV_p-LuCnl-2	j-i-Atss18_c-d6Elo(Pp_GA2)	c-d6Des(Ot_febit)	j-p-BnFAE_t-PvARC	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
LALJAU (n=18)	3.1 (T0: 2)									1.3	(T0: 1.1)			
LALFWA (n=16)	3.1 (T0: 1.8)									2.6	(T0: 1.9)			(T0: 1.9)
LALJDF (n=17)	3.2 (T0: 2)									3.3	(T0: 2)			
LALTHK (n=15)	3.8 (T0: 2.1)									2.1	(T0: 1.1)			
LALTLE (n=18)	3.4 (T0: 2.8)									2.4	(T0: 2.4)			
LALIVY (n=16)	3 (T0: 1.9)									3.1	(T0: 2.1)			
LALJCX (n=16)	3.4 (T0: 1.9)									3.4	(T0: 1.8)			

Table 25: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc The events are indicated in the first column, along with the number of T2 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALJAU (n=18)	4.5 ± 0.1	0.1 ± 0	0 ± 0	3.6 ± 0.4	21.5 ± 1.8	31.6 ± 0.9	0.8 ± 0.2	3.3 ± 0.3	1.9 ± 0.7	0.2 ± 0.1	0.9 ± 0.1	0.7 ± 0.1	0.8 ± 0.4	0.1 ± 0.2	3.7 ± 0.6	1.6 ± 0.4	8.6 ± 2.7	9.6 ± 1.4	0.3 ± 0	0 ± 0	0.8 ± 0.2	3.3 ± 0.6	0 ± 0	1.7 ± 0.5	0.1 ± 0.2	
LALFWA (n=16)	4.5 ± 0.5	0.1 ± 0	0 ± 0	3.5 ± 0.5	20 ± 2	30 ± 2.1	1 ± 0.1	3.8 ± 0.4	2.6 ± 0.3	0.4 ± 0.1	0.8 ± 0.1	0.6 ± 0	0.2 ± 0.1	0 ± 0	3.7 ± 0.4	1.9 ± 0.4	5.6 ± 2.3	11.6 ± 2.2	0.2 ± 0.1	0 ± 0	1.4 ± 0.3	4.7 ± 1.1	0 ± 0	2.6 ± 0.8	0.5 ± 0.4	0.4 ± 0
LALJDF (n=17)	4.3 ± 0.7	0.2 ± 0.1	0 ± 0.1	3.3 ± 0.5	20.7 ± 4.1	29.3 ± 4	2.5 ± 5.9	4.1 ± 0.4	2.4 ± 0.5	0.7 ± 1.1	0.8 ± 0.1	0.7 ± 0.1	0.3 ± 0.1	0 ± 0	2.7 ± 0.4	1.7 ± 0.3	4.6 ± 0.6	13.1 ± 3	0.3 ± 0	0 ± 0	0.9 ± 0.3	4.7 ± 1.2	0.1 ± 0.3	2.2 ± 0.6	0.2 ± 0.2	0.2 ± 0
LALTHK (n=15)	4.7 ± 0.6	0.1 ± 0.1	0 ± 0	3.7 ± 0.4	21.4 ± 1.8	32.9 ± 1.9	0 ± 0.1	4.9 ± 0.6	0.6 ± 0.1	0 ± 0	1 ± 0.1	0.9 ± 0.1	1.7 ± 0.3	0.7 ± 0.2	2.2 ± 0.3	1.6 ± 0.2	4.3 ± 0.8	18.9 ± 2.5	0.4 ± 0.1	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	
LALTLE (n=18)	4.6 ± 0.6	0.1 ± 0	0 ± 0	3.6 ± 0.4	24.1 ± 4.5	29.8 ± 2.2	1 ± 0.3	4.2 ± 0.5	2 ± 0.6	0.3 ± 0.1	0.9 ± 0.1	0.7 ± 0.1	0.3 ± 0.3	0 ± 0.1	3 ± 0.2	2 ± 0.3	3.8 ± 0.9	10.9 ± 3	0.1 ± 0.1	0 ± 0	1.4 ± 0.6	4.7 ± 1.1	0 ± 0	2.3 ± 0.8	0.2 ± 0.3	0.6 ± 0.1
LALIVY (n=16)	5.4 ± 1	0.2 ± 0.1	0 ± 0	3.6 ± 0.4	21.6 ± 2.9	30.9 ± 2	0.9 ± 0.2	4.4 ± 0.5	2.1 ± 0.5	0.3 ± 0.1	0.8 ± 0.1	0.6 ± 0.2	0.3 ± 0.2	0.1 ± 0.1	2.8 ± 0.2	1.9 ± 0.3	4.2 ± 1.2	10.4 ± 1.8	0.3 ± 0.1	0 ± 0	1.3 ± 0.3	4.4 ± 0.9	0 ± 0	2.4 ± 0.6	0.6 ± 0.2	0.5 ± 0.3
LALJCX (n=16)	5 ± 0.1	0.2 ± 0	0 ± 0	3.4 ± 0.2	23.9 ± 1.6	32.4 ± 1.1	1.1 ± 0.1	4.1 ± 0.4	2.5 ± 0.3	0.4 ± 0	0.8 ± 0	0.7 ± 0	0.2 ± 0	0 ± 0	2.5 ± 0.7	1.3 ± 0.3	4.2 ± 0.3	9.9 ± 0.7	0.3 ± 0	0 ± 0	1.1 ± 0.2	3.8 ± 0.3	0 ± 0	1.7 ± 0.2	0.4 ± 0.2	

Table 26: Fatty acid profiles of one T2 seed batch per event harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T2 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALJAU (n=1)	4.9	0.2	0.0	4.7	18.8	30.6	1.1	3.1	3.6	0.4	1.0	0.6	0.1	0.0	2.4	1.1	5.7	12.6	0.4	0.0	1.3	4.4	0.0	2.8	0.0	0.0
LALFWA (n=1)	3.8	0.1	0.0	3.2	16.1	26.2	1.2	4.4	3.0	0.5	0.7	0.7	0.3	0.1	2.9	2.4	3.6	16.0	0.1	0.0	1.9	7.4	0.0	4.2	0.7	0.4
LALJDF (n=1)	3.5	0.1	0.1	2.8	15.8	27.7	1.2	3.7	3.6	0.5	0.7	0.7	0.3	0.0	2.6	1.9	5.5	18.0	0.3	0.0	1.4	6.2	0.0	3.2	0.1	0.2
LALTHK (n=1)	4.7	0.0	0.0	4.2	18.6	30.7	0.0	4.6	0.6	0.0	1.1	0.9	2.0	1.0	2.2	1.7	4.6	22.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	
LALTLE (n=1)	3.3	0.2	0.1	2.8	15.0	24.9	1.5	3.3	3.3	0.5	0.7	0.6	0.5	0.0	3.1	2.2	5.7	17.6	0.3	0.0	2.4	6.9	0.0	4.1	0.5	0.5
LALIVY (n=1)	5.9	0.3	0.0	3.9	16.5	26.5	0.9	4.2	2.3	0.5	0.9	0.7	0.5	0.3	2.6	2.2	3.9	14.2	0.4	0.0	1.7	6.7	0.0	4.2	0.6	0.0
LALJCX (n=1)	6.1	0.7	0.2	2.3	22.0	15.1	15.3	6.6	2.5	0.5	0.6	0.6	0.5	0.0	1.2	0.9	4.6	10.0	0.4	0.0	0.8	5.5	0.0	3.5	0.0	0.0

Table 27: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where rated per event. DFF: days to first

flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), NoI: number of lobes(#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad),

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
LALJAU (n=18)	62.2 ± 2.3	1 ± 0	1 ± 0	1 ± 0	1.9 ± 1	3 ± 0	3 ± 0	5 ± 0	1.3 ± 0.7	4 ± 0	129.7 ± 5.5	4.7 ± 0.2	2.1 ± 1
LALFWA (n=16)	61.6 ± 3.3	1 ± 0	1.2 ± 0.8	1 ± 0	3.5 ± 2.4	3 ± 0	3 ± 0	5 ± 0	3.1 ± 2.6	3.9 ± 0.5	127.7 ± 6.2	4.9 ± 0.4	3.5 ± 1.8
LALJDF (n=17)	58.7 ± 2.6	1 ± 0	1 ± 0	1 ± 0	1.6 ± 0.8	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	4 ± 0	128 ± 6.2	5 ± 0.2	2.4 ± 0.6
LALTHK (n=15)	62.1 ± 5.5	1 ± 0	1 ± 0	1 ± 0	1.7 ± 1.1	3 ± 0	3 ± 0	5 ± 0	1.1 ± 0.5	4 ± 0	124.3 ± 5	4.8 ± 0.3	3.1 ± 1.2
LALTLE (n=18)	67.8 ± 6.7	1 ± 0	1 ± 0	1 ± 0	1.7 ± 0.8	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	126.7 ± 5.2	4.4 ± 0.3	4.2 ± 1.7
LALIVY (n=16)	69.5 ± 6.2	1 ± 0	2.7 ± 1.4	1.3 ± 0.6	2.4 ± 1.4	3 ± 0	3 ± 0	5 ± 0	1.6 ± 0.9	3.3 ± 1	127.1 ± 5.8	4.4 ± 0.4	4.9 ± 3.2
LALJCX (n=16)	64.2 ± 2.7	1 ± 0	2.7 ± 0.7	1 ± 0	1.4 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	131.4 ± 5.7	4.5 ± 0.3	2.2 ± 0.9

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc cultivated in greenhouses during summer

Copy number analysis, see Table 28, indicates that the chosen events are largely homozygous for the genes encoded on the T-DNAs of VC-LJB2197-1qcz and VC-LLM306-1qcz rc. All events but LALTLE had two copies of the T-DNAs inserted into the genome. LALTLE appeared to have more than two copies with some segregation still ongoing. Based on the copy number analysis, LALJDF had integrated one copy of the d4Des(Eg_GA) gene and LALTLE was segregating for one or two copies of that gene. The EPA and DHA data in Table 29 and Table 30 indicated the events perform equally well with perhaps LALJDF accumulating less DHA, based on Table 30. Plant morphology was the same for all the events examined. As discussed above for T1 plants grown in the greenhouse, the event to event variation was minimal, suggesting that the impacts of insertion site position effects (both negative and positive) were similar for all events. The lack of insertion site effects indicates that the plasmid design/T-DNA topology was exerting a normalizing effect/mitigates insertion site effects.

Table 28: Copy number measurement of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column, along with the number of T2 plants that where measured per event. The T2 plants underwent a selection from 250 segregating T2 seedlings using half-kernel analysis, where the correlation of VCL-PUFA levels with copy number was employed to select for homozygous plants, or in case of multilocus events to selecect for plants where one or more loci are homozygous. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth. Odd results of 3 and 5 indicate that at least some of the selected T2 plants carry a heterozygous locus.

	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Des(Ot_febit) near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LLM306-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-p-BnFAE_ t-PvARC located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border.						
Event	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	c-d6Des(Ot_febit)	j-t-CaMV_p-LuCnl-2	j-i-Atss18_c-d6Elo(Pp_GA2)	c-d6Des(Ot_febit)	j-p-BnFAE_ t-PvARC	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
LALFWA (n=30)	4.0	3.6	3.7	3.9	7.7	4.6	3.7	7.7	3.5	3.7			3.5	3.5
LALJDF (n=30)	4.2	3.9	3.9	3.8	8.5	3.3	3.5	8.5	5.1	4.1			4.0	2.2
LALTLE (n=30)	5.2	4.6	4.7	5.0	8.9	4.4	1.8	8.9	2.6	3.6			4.6	3.2
LALIVY (n=30)	4.1	3.6	3.7	3.8	8.1	4.4	5.4	8.1	3.7	4.0			3.8	3.5

Table 29: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc The events are indicated in the first column, along with the number of T3 seed batches that where measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALFWA (n=30)	4.9 ± 0.2	0.3 ± 0.1	0.2 ± 0	4.4 ± 0.2	19.9 ± 0.9	29.5 ± 0.8	1.3 ± 0.1	3.2 ± 0.2	3 ± 0.2	0.4 ± 0	0.9 ± 0.1	0.6 ± 0	0.3 ± 0	0 ± 0	3.8 ± 0.6	2.1 ± 0.3	4 ± 0.4	11.3 ± 0.6	0.3 ± 0	0 ± 0	1.7 ± 0.2	4.3 ± 0.3	0 ± 0	2.5 ± 0.2	0.7 ± 0.2	0.3 ± 0
LALJDF (n=30)	5.4 ± 0.3	0.3 ± 0	0.2 ± 0	4.4 ± 0.2	21.4 ± 0.7	30.1 ± 1.1	1.2 ± 0.1	3.8 ± 0.3	2.7 ± 0.2	0.4 ± 0	0.9 ± 0	0.6 ± 0	0.1 ± 0.1	0 ± 0	2.2 ± 0.2	1.4 ± 0.1	4.3 ± 0.2	12.4 ± 0.7	0.2 ± 0.1	0 ± 0	1 ± 0.1	4.4 ± 0.4	0 ± 0	2.2 ± 0.2	0.1 ± 0.1	0.2 ± 0.1
LALTLE (n=30)	5.2 ± 0.4	0.3 ± 0	0.2 ± 0.1	4.6 ± 0.3	20.3 ± 0.8	28.7 ± 0.8	1.3 ± 0.2	3.4 ± 0.3	2.8 ± 0.2	0.4 ± 0.1	0.8 ± 0.1	0.5 ± 0.1	0.3 ± 0.1	0.1 ± 0.1	2.3 ± 0.2	1.6 ± 0.2	3.9 ± 0.2	12.1 ± 0.7	0.2 ± 0.1	0 ± 0	1.9 ± 0.2	4.9 ± 0.3	0 ± 0	2.9 ± 0.4	0.5 ± 0.1	0.3 ± 0.1
LALIVY (n=30)	5.3 ± 0.6	0.3 ± 0.1	0.2 ± 0	4.8 ± 0.5	20.4 ± 1.4	29.6 ± 1	1.2 ± 0.2	3.6 ± 0.2	2.7 ± 0.3	0.4 ± 0	0.9 ± 0.1	0.6 ± 0	0.4 ± 0.1	0.1 ± 0.1	2.5 ± 0.3	1.7 ± 0.3	4 ± 0.7	11.4 ± 0.7	0.3 ± 0	0 ± 0	1.5 ± 0.1	4.5 ± 0.4	0 ± 0	2.7 ± 0.4	0.5 ± 0.2	0.3 ± 0.1
WT Kumily (n=46)	5 ± 0.1	0.4 ± 0	0.2 ± 0	2.6 ± 0.1	66.3 ± 1.7	16.8 ± 1.3	0 ± 0	6.1 ± 0.4	0 ± 0	0 ± 0	0.9 ± 0	1.2 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.5 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 30: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALFWA (n=1)	5.4	0.4	0.2	4.6	17.5	27.9	1.1	2.9	3.3	0.4	0.9	0.5	0.3	0.0	3.7	2.0	4.5	12.7	0.3	0.0	2.2	5.0	0.0	3.2	0.6	0.3
LALJDF (n=1)	5.1	0.3	0.2	4.5	19.7	28.9	1.1	3.8	2.8	0.5	0.9	0.6	0.1	0.0	2.4	1.6	4.4	13.7	0.3	0.0	1.1	5.1	0.0	2.5	0.2	0.2
LALTLE (n=1)	5.8	0.1	0.1	5.5	20.1	27.3	1.9	3.1	3.5	0.2	0.4	0.3	0.2	0.0	1.9	0.7	4.0	13.4	0.1	0.0	1.1	5.5	0.0	4.2	0.2	0.1
LALIVY (n=1)	5.5	0.4	0.2	4.4	18.4	28.6	1.1	3.4	3.3	0.4	0.9	0.5	0.3	0.0	2.2	1.4	5.3	12.8	0.3	0.0	1.8	5.0	0.0	3.4	0.2	0.2
LALHCY (n=1)	7.6	1.1	0.7	2.3	19.7	25.6	0.9	6.3	3.6	0.7	0.8	0.6	0.0	0.0	1.2	1.1	3.9	10.4	0.0	0.0	1.0	7.0	0.0	3.4	0.0	0.0

Table 31: Phenotypic rating of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column, along with the number of T2 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes(#), PH: plant height (cm), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	Oil	Protein
LALFWA (n=30)	57.3 ± 2.2	9 ± 0	8.9 ± 0.4	8.9 ± 0.4	7.2 ± 1	3 ± 0	3 ± 0	5 ± 0	8 ± 1.2	3.9 ± 0.4	126.8 ± 4.3		
LALJDF (n=30)	58.1 ± 2.5	9 ± 0	9 ± 0	9 ± 0	7.7 ± 0.5	3 ± 0	3 ± 0	5 ± 0	8.2 ± 0.9	4 ± 0	130.2 ± 0.9		
LALTLE (n=30)	59.9 ± 2.8	9 ± 0	8.1 ± 1.3	8.8 ± 0.5	7.2 ± 0.9	3 ± 0	3 ± 0	5 ± 0	7.7 ± 1.3	3.9 ± 0.5	128 ± 2.8		
LALIVY (n=30)	59.6 ± 2.9	9 ± 0	8.8 ± 0.9	8.6 ± 1	6.8 ± 1.3	3 ± 0	3 ± 0	5 ± 0	7.3 ± 1.7	3.8 ± 0.6	126.8 ± 3.3		
WT Kumily (n=46)												34.9 ± 1.1	32.2 ± 1

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc cultivated in field trials in USDA growth zones 3a-4b and 5a during summer.

The field data on Table 32 and Table 33 indicate a consistent performance across generations for T2 and T3. The data show that the PUFA (EPA and DHA) accumulation was higher for greenhouse grown plants. Besides levels in VLC-PUFA, there was also a difference in seed oil content observed compared to the greenhouse (e.g. comparing Table 34 and Table 31). Results of this analysis are described in Example 20. The field data also demonstrate that the greenhouse data accurately indicated the consistency between events with respect to EPA and DHA accumulation, though not overall levels. As remarked upon above for T1 and T2 plants grown in the greenhouse, the event to event variation was low for this construct, indicating that the T-DNAs/T-DNA design seem to be exerting a buffering/mitigating effect on gene silencing and other positional effects.

Table 32: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the field corresponding to USDA growth zones 3a-4b and 5a. Field trials of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc are given below. The events are indicated in the first column, along with the number of T3 seed aliquots representing a plot were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALFWA (n=30)	5.1 ± 0.2	0.3 ± 0.1	0.1 ± 0	2.6 ± 0.2	25.1 ± 1.8	30.8 ± 1.4	1.1 ± 0.1	5.9 ± 0.9	1.8 ± 0.2	0.3 ± 0.1	0.7 ± 0	0.7 ± 0	0.4 ± 0.1	0.1 ± 0.1	2.6 ± 0.3	1.4 ± 0.2	4.4 ± 1.2	8.5 ± 1.2	0.3 ± 0	0 ± 0	1.2 ± 0.2	4.4 ± 0.5	0 ± 0	1.4 ± 0.2	0.5 ± 0.2	0.3 ± 0.1
LALJDF (n=30)	5.1 ± 0.3	0.3 ± 0	0.1 ± 0	2.7 ± 0.2	24.4 ± 1.7	29.4 ± 1.5	1.2 ± 0.1	5.6 ± 0.4	1.8 ± 0.2	0.3 ± 0	0.7 ± 0	0.7 ± 0	0.4 ± 0.1	0.1 ± 0	2.2 ± 0.1	1.3 ± 0.1	4.5 ± 0.4	11.1 ± 0.9	0.2 ± 0.1	0 ± 0	0.9 ± 0.1	5.1 ± 0.4	0 ± 0	1.4 ± 0.2	0.1 ± 0.1	0.4 ± 0.1
LALTLE (n=30)	5.4 ± 0.2	0.3 ± 0.1	0.1 ± 0	2.7 ± 0.2	26.4 ± 3.2	28.1 ± 1	1.2 ± 0.2	5.6 ± 0.6	1.7 ± 0.3	0.3 ± 0.1	0.7 ± 0	0.7 ± 0	0.5 ± 0.2	0 ± 0.1	2.1 ± 0.2	1.2 ± 0.1	3.9 ± 0.5	9.6 ± 1.2	0.2 ± 0.1	0 ± 0	1.5 ± 0.2	5.3 ± 0.6	0 ± 0	1.5 ± 0.2	0.4 ± 0.2	0.5 ± 0.1
LALIVY (n=29)	5.2 ± 0.4	0.3 ± 0.1	0.1 ± 0	2.9 ± 0.3	26.7 ± 3.1	28.3 ± 2.2	1 ± 0.2	6.3 ± 0.6	1.4 ± 0.3	0.3 ± 0	0.7 ± 0.1	0.8 ± 0.1	0.6 ± 0.2	0.2 ± 0.1	2.1 ± 0.2	1.4 ± 0.1	3.3 ± 0.5	9.2 ± 1.1	0.3 ± 0.1	0 ± 0	1.3 ± 0.1	5 ± 0.5	0 ± 0	1.5 ± 0.2	0.5 ± 0.1	0.5 ± 0.1
WT Kumily (n=60)	5 ± 0.3	0.4 ± 0	0.1 ± 0.1	2 ± 0.1	56.2 ± 4.2	23.3 ± 1.7	0 ± 0.1	9.5 ± 0.7	0.1 ± 0.2	0 ± 0	0.7 ± 0	1.1 ± 0.1	0.1 ± 0.1	0 ± 0	0.2 ± 0.3	0.1 ± 0.3	0.2 ± 0.5	0.4 ± 1.1	0.3 ± 0.1	0 ± 0	0 ± 0.2	0.2 ± 0.6	0 ± 0	0 ± 0.2		

Table 33: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in USDA growth zones 3a-4b and 5a field trials of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALFWA (n=1)	5.2	0.3	0.1	2.6	25.0	28.2	1.1	5.0	2.1	0.4	0.6	0.6	0.3	0.0	2.7	1.4	4.5	10.5	0.3	0.0	1.4	5.2	0.0	1.8	0.4	0.3
LALJDF (n=1)	5.7	0.3	0.1	2.7	23.1	23.6	1.3	6.0	2.3	0.4	0.8	0.8	0.4	0.0	2.3	1.3	5.4	13.5	0.3	0.0	1.0	6.3	0.0	1.8	0.0	0.3
LALTLE (n=1)	5.5	0.3	0.1	2.6	24.9	26.7	1.3	4.7	2.1	0.4	0.7	0.6	0.4	0.1	2.1	1.2	5.0	10.9	0.3	0.0	1.8	5.8	0.0	1.9	0.2	0.5
LALIVY (n=1)	5.9	0.2	0.1	3.5	24.5	23.7	1.3	5.6	2.1	0.4	0.9	0.8	0.5	0.0	2.5	1.4	4.8	11.3	0.3	0.0	1.7	5.9	0.0	1.9	0.4	0.4

Table 34: Phenotypic rating of T2 plants cultivated in the field of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM306-1qcz rc. The events are indicated in the first column, along with the number of field plots that where rated per event. Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	Oil	protein
LALFWA (n=30)	38.2 ± 1	27.9 ± 0.6
LALJDF (n=30)	37.6 ± 1.2	27.9 ± 0.8
LALTLE (n=30)	38.2 ± 0.9	27.5 ± 0.7
LALIVY (n=29)	37.6 ± 0.6	27.8 ± 0.5
WT Kumily (n=60)	38.7 ± 1.1	

Example 11: Plants containing the T-DNAs of plasmid VC-LJB2197-1qcz and VC-LLM337-1qcz rc (combination B in example 5) for production of EPA and DHA in seeds

In this example, the genetic elements required for EPA and DHA synthesis were transferred into the plant genome on two different T-DNAs. To this end, the two different plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc containing two different T-DNAs were cloned into agrobacteria, and plant tissue was incubated according to Example 5 at the same time with these two agrobacterial cultures that were identical apart from containing either VC-LJB2197-1qcz or VC-LLM337-1qcz rc. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of VC-LJB2197-1qcz. Only those plants were kept, that also contained the T-DNA of plasmid VC-LLM337-1qcz rc as confirmed by PCR, conducted as described in Example 24, which contains PCR protocols for both gene expression and copy number analysis. Only plants containing the T-DNA of plasmid VC-LJB2197-1qcz as well as the T-DNA of plasmid VC-LLM337-1qcz rc combined all the genetic elements required for EPA and DHA synthesis in seeds. The genetic elements of VC-LJB2197-1qcz and the function of each element were listed in Table 1. The genetic elements of VC-LLM337-1qcz rc and the function of each element were listed in Table 4. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LJB2197-1qcz and VC-LLM337-1qcz rc that were required for EPA and DHA synthesis are additionally listed on Table 35.

Table 35: Combined list of genes essential of EPA and DHA synthesis carried by the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc.

Genes encoding enzmyes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA)	VC-LJB2197-1qcz	1196	Delta-12 desaturase from *Phythophthora sojae*
c-d6Des(Ot_febit)	VC-LJB2197-1qcz	1370	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Pp_GA2)	VC-LJB2197-1qcz	872	Delta-6 elongase from *Physcomitrella patens*
c-d6Elo(Tp_GA2)	VC-LJB2197-1qcz	818	Delta-6 elongase from *Thalassiosira pseudonana*
c-d5Des(Tc_GA2)	VC-LJB2197-1qcz	1319	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	VC-LLM337-1qcz rc	1085	Omega-3-desaturase from *Phythophthora infestans*
c-o3Des(Pir_GA)	VC-LLM337-1qcz rc	1091	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	VC-LLM337-1qcz rc	902	Delta-5 elongase from *Ostreococcus tauri*

Genes encoding enzmyes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length	Enzymatic function and source of encoded protein
c-d4Des(Eg_GA)	VC-LLM337-1qcz rc	1625	Delta-4 desaturase from *Euglena gracilis*
c-d4Des(Tc_GA)	VC-LLM337-1qcz rc	1559	Delta-4 desaturase from *Thraustochytrium* sp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in greenhouses during summer

Table 34 indicates that the T-DNA integrated as predominantly single and double copies. As observed in Example 10 there was an increase in EPA and DHA between one copy and two copies of the T-DNA from the two constructs, see Table 36, but less of a difference between two and three copies. The T1 data in Table 37 reflects this as well. As noted in Example 10, there was no observed alteration of the phenotype of the plants bearing the T-DNA from both constructs, regardless of copy number (up to three).

Table 36: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49, tc: all T0 plants where the average of all copy number assays listed in this table was 2.51-3.49.

Category of T0 plants	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-i-Atss18_c-d6Elo(Pp_GA2) near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LLM337-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-t-PvARC-p3 located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border.							
	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-t-CaMV_p-LuCnl-2	c-d6Elo(Pp_GA)	j-i-Atss18_c-d6Elo(Pp_GA2)	j-t-PvARC-p3	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	j-i-Atss15_c-o3Des(Pi_GA2)	c-o3Des(Pir_GA)	j-p-VfSBPperm3_c-o3Des(Pir_GA)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
sc (n=563)	1.1					1.1			1.2	1.2	1.2	1.2			1.2
dc (n=423)	1.4					1.6			2.0	1.9	2.0	1.8			2.2
tc (n=17)	2.0					2.6			2.8	1.8	3.2	2.4			3.8

Table 37: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 36. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=563)	5.1 ± 0.6	0.3 ± 0.1	0.1 ± 0	3 ± 0.5	40.6 ± 6.2	29.4 ± 4.2	0.7 ± 4.7	6 ± 1.1	0.5 ± 0.6	0.1 ± 0.2	0.8 ± 0.1	0.9 ± 0.2	0.9 ± 0.6	0.3 ± 0.3	1.6 ± 0.8	0.9 ± 0.5	2.1 ± 1.3	3.4 ± 1.2	0.3 ± 0.1	0 ± 0	0.4 ± 0.3	1.5 ± 0.5	0 ± 0	0.6 ± 0.3	0.3 ± 0.3	
dc (n=423)	5 ± 0.8	0.3 ± 0.1	0.1 ± 0	3.1 ± 0.6	38.6 ± 8.2	28.8 ± 5.3	1.1 ± 5.9	5.9 ± 1.2	0.7 ± 0.6	0.1 ± 0.1	0.8 ± 0.1	0.9 ± 0.2	0.8 ± 0.6	0.3 ± 0.3	1.7 ± 0.9	1 ± 0.5	2.1 ± 1.5	4.3 ± 2	0.3 ± 0.1	0 ± 0	0.6 ± 0.4	1.9 ± 0.9	0 ± 0	0.8 ± 0.5	0.4 ± 0.3	
tc (n=17)	5 ± 0.9	0.3 ± 0.1	0.1 ± 0	3.1 ± 0.7	39.1 ± 8.1	28.4 ± 4.5	0.5 ± 0.3	6.1 ± 1.5	0.9 ± 0.6	0.2 ± 0.1	0.8 ± 0.2	0.9 ± 0.2	0.7 ± 0.6	0.3 ± 0.2	2.1 ± 2.1	1.2 ± 1	1.9 ± 2.4	4 ± 2.9	0.3 ± 0.1	0 ± 0	0.7 ± 0.4	1.9 ± 1.1	0 ± 0	0.8 ± 0.5	0.8 ± 0.9	

Table 38: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 36. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	3.6	0.1	0.1	2.8	37.6	22.1	0.8	6.4	0.5	0.3	0.8	1.2	1.1	0.6	1.8	2.1	2.9	9.0	0.4	0.0	0.5	3.5	0.0	1.6	0.3	
dc (n=1)	7.1	0.0	0.0	4.5	3.2	1.5	44.5	0.3	0.0	0.0	1.0	1.1	2.3	0.5	9.8	1.8	0.0	12.6	0.4	0.0	1.3	4.9	0.0	2.8	0.6	
tc (n=1)	3.4	0.1	0.0	2.8	29.4	27.4	0.6	6.6	1.0	0.3	0.7	0.9	1.1	0.5	1.5	1.6	2.6	10.4	0.3	0.0	1.1	5.1	0.0	1.9	0.5	

Table 39: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 36. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
sc (n=563)	66.1 ± 8.3	1 ± 0	1.4 ± 1.1	1.7 ± 1.6	3 ± 2.8	3 ± 0	3 ± 0.1	5 ± 0	3.2 ± 2.6	3.8 ± 0.6	119.5 ± 9.8	4.7 ± 0.6	4.8 ± 2.5
dc (n=423)	66 ± 7.5	1 ± 0	1.4 ± 1.2	1.7 ± 1.4	3 ± 2.9	3 ± 0	3 ± 0.1	5 ± 0.1	3.1 ± 2.6	3.7 ± 0.7	119.2 ± 9.5	4.6 ± 0.6	5 ± 2.3
tc (n=17)	64.6 ± 7.4	1 ± 0	1.5 ± 1.5	2.8 ± 2.5	4.4 ± 3.7	3 ± 0	3 ± 0	5 ± 0	4.5 ± 3.5	3.9 ± 0.5	117.1 ± 10.5	4.6 ± 0.4	6.5 ± 2.2

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in greenhouses during winter

The data on Table 39 indicate that the integration of these two T-DNA's (VC-LJB2197-1qcz and VC-LLM337-1qcz rc), has occurred in such a way as to introduce copy number variation of individual genes on a given T-DNA (indicating truncations and deletions along with multiple copies being inserted). For example the event LAMABL on Table 39 was segregating for a single copy of AHAS (homozygous), two copies of j-t-StCAT_p2_p-LuPXR (homozygous), possibly three copies of c-d6Elo(Pp_GA) likely homozygous, though it could be three copies which are not homozygous for all three, and three copies of j-i-Atss18_c-d6Elo(Pp_GA2) (homozygous for all three). Data on Table 42 to Table 45 for fatty acid profile indicates some variation among the events, though not large differences. The highest event average for both DHA and EPA for the events listed on Table 41 was LAMRHL which has DHA of 1.9 and EPA of 10.5 with respect to percent of the total fatty acid content of the seed and contains what was likely a single copy of the T-DNA of of VC-LJB2197-1qcz still segregating, while VC-LLM337-1qcz rc seems to be a single copy homozygous insertion. The event, LANMGC, with the lowest levels of EPA and DHA combined, contained EPA of 3.7 and 0.8 for DHA with respect to percent of the total fatty acid content of the seed. LANMGC appeared to be homozygous single copy for VC-LJB2197 and carried at least two separate integrations of VC-LLM337. For the highest single plant level of EPA and DHA, event LAPWLP had 3.2 percent of DHA and 15.9 percent of EPA with respect to percentage of total fatty acids in the seed, Table 43. The data indicate that the location of the insertion site is important for EPA and DHA accumulation in this combination of constructs. As seen in previous examples, comparison of single copy insertions versus double copy insertions revealed that between single copy and double copy containing plants there was an increase in VLC-PUFA levels, but between double and triple copy containing plants there was less distinction. Table 46 displays phenotypic scoring/assessment and shows some small differences in aerial phenotype among events and between the transformed plants and untransformed reference.

Table 40: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. The T1 plants underwent a selection from 250 segregating T1 seedlings using half-kernel analysis, where the correlation of VCL-PUFA levels with copy number was employed to select for homozygous plants, or in the case of multilocus events to selecect for plants where one or more loci are homozygous. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth. Odd results of 3 and 5 indicate that at least some of the selected T1 plants carry a heterozygous locus.

Event	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-i-Atss18_c-d6Elo(Pp_GA2) near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.							Copy number assays targeting the T-DNA of VC-LLM337-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-t-PvARC-p3 located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.							
	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-t-CaMV_p-LuCnl-2	c-d6Elo(Pp_GA)	j-i-Atss18_c-d6Elo(Pp_GA2)	j-t-PvARC-p3	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	j-i-Atss15_c-o3Des(Pi_GA2)	c-o3Des(Pir_GA)	j-p-VfSBPperm3_c-o3Des(Pir_GA)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
LALHCY (n=15)	2.9 (T0: 1.8)	4.4		4.6	3.5	1.9 (T0: 1.1)	2.0	2.9	2.9 (T0: 2.1)		(T0: 2.6)	(T0: 2.1)	4.5		3.0
LALIAO (n=15)	3 (T0: 1.8)	2.7		3.3	3.6	2.8 (T0: 1.9)	3.1	3.2	2.8 (T0: 2)		(T0: 2.2)	(T0: 1.9)	2.9		1.5
LALJKA (n=15)	2 (T0: 1.1)	2.0		2.0	4.1	3.6 (T0: 1.9)	3.8	3.5	3.8 (T0: 2)		(T0: 1.9)		4.0		5.5
LALLTL (n=11)	1.7 (T0: 1.8)	3.5		3.5	3.1	3.2 (T0: 3)	3.2	2.3	2.4 (T0: 2)		(T0: 1.9)		2.3		2.8
LALQAM (n=15)	3.4 (T0: 1.9)	3.3		3.3	3.1	3.3 (T0: 1.9)	3.3	2.9	3.1 (T0: 2)		(T0: 2.1)		1.6		1.6
LALQDS (n=14)	2.7 (T0: 2)	2.8		3.6	2.3	2.3 (T0: 2.2)	2.3	2.8	2.9 (T0: 2)		(T0: 1.9)		4.0		2.8
LALRCQ (n=14)	3.2 (T0: 2)	3.2		3.3	3.0	3.2 (T0: 2.1)	3.3	3.0	3.2 (T0: 2.1)		(T0: 2.2)		4.4		4.3
LALWKF (n=14)	1.9 (T0: 1.2)	1.9		4.8	4.8	4.7 (T0: 3.2)	4.8	1.4	1.3 (T0: 1)		(T0: 1)		1.3		1.3
LAMABL (n=8)	1.8 (T0: 1)	1.9		3.6	5.8	5.2 (T0: 3.7)	5.6	1.9	1.8 (T0: 1)		(T0: 1)	(T0: 1.2)	1.8		3.5

LAMCKI (n=10)	2 (T0: 1)	3.9		3.6	2.7	2.3 (T0: 1)	2.0	3.8	4 (T0: 1.9)		(T0: 2.1)	(T0: 1.8)	3.9		3.9
LAMCLE (n=14)	3 (T0: 2)	3.0		4.3	4.2	4.2 (T0: 2.9)	4.4	2.5	2.4 (T0: 2)		(T0: 2)	(T0: 2.1)	3.4		1.3
LAMCLF (n=9)	1.6 (T0: 1)	3.3		4.1	4.7	4.4 (T0: 2.8)	3.8	2.2	1.8 (T0: 2.1)		(T0: 1.9)	(T0: 1.4)	1.8		1.8
LAMEUB (n=15)	1.9 (T0: 1)	2.1		3.6	3.9	3.7 (T0: 2.2)	3.8	1.3	1.2 (T0: 1)		(T0: 1)		1.2		1.1
LAMEUU (n=13)	1.9 (T0: 0.9)	3.8		3.3	5.6	5.4 (T0: 2.8)	5.2	3.1	3.8 (T0: 1.9)		(T0: 1.9)		3.7		3.7
LAMFJO (n=15)	2 (T0: 1.1)	2.1		2.0	2.1	2 (T0: 0.9)	2.0	1.1	1.1 (T0: 0.5)		(T0: 0.8)		1.2		1.1
LAMIRY (n=10)	1.9 (T0: 1)	1.9		2.6	2.7	2.7 (T0: 2)	2.8	1.7	2 (T0: 2.3)		(T0: 2)		3.1		2.1
LAMJIC (n=9)	1.9 (T0: 1.1)	1.7		1.6	2.5	1.8 (T0: 1)	1.8	2.3	1.8 (T0: 1)		(T0: 1)		1.8		1.8
LAMPJB (n=13)	2.8 (T0: 2)	2.9		3.6	4.4	4.1 (T0: 3)	4.1	2.6	2.8 (T0: 2.1)		(T0: 1)	(T0: 1.8)	2.8		2.6
LAMQDL (n=14)	2 (T0: 1)	2.1		2.3	2.6	2.3 (T0: 1)	2.0	0.0	2.6 (T0: 2)		(T0: 1)	(T0: 1)	1.3		1.3
LAMQNE (n=14)	2.6 (T0: 1.1)	2.6		2.7	2.8	2.8 (T0: 1.3)	2.5	2.0	1.5 (T0: 1.1)		(T0: 0.9)	(T0: 1.9)	4.0		4.2
LAMQSF (n=14)	3.5 (T0: 2.1)	4.5		3.8	4.7	4.2 (T0: 3.2)	4.0	2.9	3.7 (T0: 3.9)		(T0: 4.2)	(T0: 2.2)	3.6		3.6
LAMRCO (n=14)	2.8 (T0: 1.9)	3.7		6.6	6.5	6 (T0: 4.1)	5.5	1.8	1.3 (T0: 1.1)		(T0: 1)	(T0: 2.1)	3.9		2.5
LAMRDS (n=15)	3.2 (T0: 1.9)	3.2		3.0	3.6	3 (T0: 1.8)	3.0	3.0	3 (T0: 2)		(T0: 1.9)	(T0: 1.7)	3.1		2.6
LAMRHL (n=14)	2 (T0: 1.3)	2.2		3.2	2.8	2.1 (T0: 1.5)	1.9	4.1	3.8 (T0: 2.7)		(T0: 1.3)	(T0: 1.3)	1.9		2.0
LAMRJK (n=15)	3 (T0: 2)	3.0		2.9	1.3	1.2 (T0: 0.9)	1.0	3.0	4.5 (T0: 2.9)		(T0: 1.9)	(T0: 1.7)	2.9		2.7
LAMRNQ (n=9)	2.2 (T0: 1.9)	2.1		2.2	2.3	2.3 (T0: 2.1)	2.1	2.5	2 (T0: 1.9)		(T0: 2)	(T0: 1.9)	2.0		2.7
LAMVUB (n=15)	2.1 (T0: 1.1)	2.1		2.1	2.7	2.1 (T0: 1)	2.1	0.6	0.8 (T0: 0.8)		(T0: 0.9)		1.1		0.8
LAMYDP (n=14)	3.9 (T0: 2)	4.0		3.7	4.2	3.8 (T0: 1.9)	3.9	3.2	3.4 (T0: 2.1)		(T0: 1.9)	(T0: 1.7)	3.3		3.2
LANBCH (n=14)	3.5 (T0: 1.9)	3.2		3.3	4.0	3.5 (T0: 2)	3.4	3.5	3 (T0: 1.8)		(T0: 2)		3.3		3.3
LANCEG (n=4)	4 (T0: 2.1)	4.0		3.5	5.9	5.4 (T0: 2.9)	3.6	3.6	4.1 (T0: 2)		(T0: 2)		4.1		1.9
LANCOX (n=10)	2.2 (T0: 1)	2.5		2.2	5.4	5.1 (T0: 4.3)	4.5	1.7	1.7 (T0: 1)		(T0: 1.1)		1.8		2.6
LANFEF (n=15)	2.1 (T0: 1.1)	2.0		2.3	2.6	2.1 (T0: 1)	2.1	1.0	0.7 (T0: 1.1)		(T0: 1)	(T0: 1.8)	2.9		2.9
LANMGC (n=15)	4.2 (T0: 1.9)	4.0		4.1	4.7	4.2 (T0: 2)	4.2	2.2	3.8 (T0: 1.9)		(T0: 2)		4.0		6.0
LANMOM (n=10)	1.4 (T0: 1.2)	1.4		3.0	2.7	2 (T0: 1.1)	1.5	3.5	2.9 (T0: 1.9)		(T0: 1.9)		2.9		4.8
LANPMZ (n=13)	2.1 (T0: 1.1)	2.1		2.0	2.3	2.2 (T0: 1)	2.2	2.0	2.1 (T0: 1.1)		(T0: 1.1)		2.1		1.9
LANTLE (n=15)	2.7 (T0: 2)	2.8		2.7	3.3	2.8 (T0: 2)	3.0	2.5	2.2 (T0: 2)		(T0: 1.9)		2.3		2.3
LANTSP (n=12)	1.4 (T0: 1)	1.3		2.9	3.7	3 (T0: 1.9)	3.0	0.6	1.5 (T0: 0.9)		(T0: 1.6)		2.5		3.3
LANUCB (n=14)	2 (T0: 1.1)	2.1		4.6	4.5	3.5 (T0: 2.1)	3.1	1.1	0.9 (T0: 2.1)		(T0: 2.8)		2.3		2.3
LAOBGQ (n=15)	1.4 (T0: 1)	1.4		6.1	5.2	4 (T0: 2.8)	4.2	1.6	2.7 (T0: 1.8)		(T0: 2.1)	(T0: 1.8)	2.8		4.0

LAOHLR (n=14)	1.9 (T0: 1.2)	4.9		4.0	4.3	3.7 (T0: 2)	3.1	2.1	1.7 (T0: 1.1)		(T0: 1)		1.7		1.7
LAOJAT (n=15)	2.2 (T0: 1.9)	3.4		3.2	3.8	3.4 (T0: 3)	3.3	2.3	2.2 (T0: 1.9)		(T0: 1.9)	(T0: 1.9)	2.3		1.2
LAOKLP (n=15)	2.1 (T0: 0.8)	2.1		2.1	2.5	2.2 (T0: 1)	2.1	1.4	1.2 (T0: 0.7)		(T0: 1)	(T0: 0.6)	1.2		1.2
LAOKTE (n=15)	3 (T0: 2)	2.8		3.5	3.5	3.3 (T0: 2.1)	3.2	3.0	2.4 (T0: 2)		(T0: 1.9)	(T0: 2.1)	2.5		2.4
LAPKLS (n=12)	3.4 (T0: 2.1)	3.1		3.6	4.2	3.1 (T0: 2.1)	3.2	2.5	1.9 (T0: 2)		(T0: 2.1)		2.0		2.1
LAPKXM (n=15)	3.2 (T0: 1.8)	3.2		3.8	4.2	3.3 (T0: 2)	3.4	3.7	2.9 (T0: 1.9)		(T0: 1.9)		3.6		0.0
LAPKZJ (n=15)	3.3 (T0: 1.4)	3.2		3.6	4.3	3.2 (T0: 1.9)	3.3	2.0	1.6 (T0: 2)		(T0: 1.9)		1.7		1.6
LAPWJD (n=14)	2.1 (T0: 1.1)	2.0		2.3	2.8	2.1 (T0: 1)	2.1	2.4	2 (T0: 1)		(T0: 1)		2.2		2.1
LAPWLP (n=14)	1.3 (T0: 1.1)	1.2		3.1	3.4	2.8 (T0: 1.9)	2.9	0.0	1.3 (T0: 1)		(T0: 1.1)		2.3		2.3
LAQYTA (n=15)	4.5 (T0: 2.8)	5.1		5.0	3.2	2.6 (T0: 2.1)	2.8	2.4	2.2 (T0: 1.9)		(T0: 2)	(T0: 2.4)	3.2		3.3
LAQYUT (n=15)	4.3 (T0: 1.9)	3.9		4.6	4.3	3 (T0: 2)	2.8	3.6	2.8 (T0: 1.6)		(T0: 1.9)	(T0: 0.6)	3.0		4.3
LAQYWQ (n=15)	2.6 (T0: 1.2)	2.8		5.6	5.9	4.5 (T0: 3)	4.6	3.2	2.7 (T0: 2)		(T0: 1.9)	(T0: 2.2)	2.6		1.4
LAQZME (n=12)	1.4 (T0: 1.2)	1.3		3.7	4.4	3.8 (T0: 2.3)	4.0	1.8	1.4 (T0: 1.1)		(T0: 1.2)	(T0: 1.2)	1.4		1.3

Table 41: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; sc: all T1 plants where the average of all copy number assays listed in this table was 1.51-2.49, dc: all T1 plants where the average of all copy number assays listed in this table was 3.51-4.49, tc: all T1 plants where the average of all copy number assays listed in this table was 5.51-6.49. The number of T1 plants fullfilling these criteria are displayed in parentheses.

Event	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with assay A1 located near the left T-DNA border and assay A13 near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with assay A1 located near the left T-DNA border and assay A13 near the right T-DNA border.						
	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-t-CaMV_p-LuCnl-2	c-d6Elo(Pp_GA)	j-i-Atss18_c-d6Elo(Pp_GA2)	j-t-PvARC-p3	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	j-i-Atss15_c-o3Des(Pi_GA2)	c-o3Des(Pir_GA)	j-p-VfSBPperm3_c-o3Des(Pir_GA)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
sc (n=296)	1.9	2.1		2.6	2.7	2.4	2.3	1.5	1.6				1.8		1.7
dc (n=198)	3.4	3.7		4.2	4.8	4.2	4.2	3.2	3.4				3.8		3.6
tc (n=2)	4.0	5.6		7.6	7.5	7.1	6.3	4.6	4.4				5.9		4.7

Table 42: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rcThe events are indicated in the first column, along with the number of T2 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALHCY (n=15)	4.9 ± 0.1	0.3 ± 0	0 ± 0	4 ± 0.2	23.7 ± 1	32 ± 0.9	1.2 ± 0.1	4.2 ± 0.4	2.2 ± 0.2	0.3 ± 0	0.8 ± 0	0.3 ± 0.3	0.2 ± 0	0.1 ± 0	4.4 ± 1.4	2.5 ± 0.7	2.9 ± 0.4	8.1 ± 0.8	0.3 ± 0	0 ± 0	1.3 ± 0.1	3.1 ± 0.3	0 ± 0	1.9 ± 0.2	1.2 ± 0.5	
LALIAO (n=15)	5 ± 0.2	0.2 ± 0	0 ± 0	2.9 ± 0.4	26.8 ± 3.4	30.8 ± 1.6	0.6 ± 0.2	5.5 ± 0.9	0.9 ± 0.4	0.2 ± 0.1	0.7 ± 0.1	0.8 ± 0.1	1.2 ± 0.7	0.4 ± 0.3	2.5 ± 0.4	1.6 ± 0.1	3.7 ± 1.3	9.9 ± 2.5	0.3 ± 0.1	0 ± 0	0.7 ± 0.3	3.3 ± 1	0 ± 0	1.2 ± 0.4	0.2 ± 0.3	0.6 ± 0.2
LALJKA (n=15)	5.4 ± 0.2	0.3 ± 0	0 ± 0	2.7 ± 0.5	25.3 ± 2.2	36.4 ± 1.1	0.6 ± 0.1	5.7 ± 0.5	2.2 ± 0.3	0.5 ± 0.1	0.7 ± 0.1	0.6 ± 0	0.1 ± 0.1	0.1 ± 0	1.7 ± 1	1 ± 0.5	2.2 ± 0.5	6.9 ± 1.5	0.3 ± 0	0 ± 0	1.3 ± 0.2	3.4 ± 0.9	0 ± 0	1.8 ± 0.4	0.6 ± 0.5	
LALLTL (n=11)	5 ± 0.2	0.3 ± 0	0 ± 0	3.6 ± 0.3	28.5 ± 4.4	31.5 ± 1.1	0.8 ± 0.2	4.6 ± 0.5	1.3 ± 0.4	0.2 ± 0	0.8 ± 0	0.6 ± 0.3	0.6 ± 0.2	0.2 ± 0.1	2.6 ± 1	1.3 ± 0.6	6 ± 2.4	6.2 ± 1.5	0.3 ± 0	0 ± 0	1.1 ± 0.4	2.4 ± 0.6	0 ± 0.1	1.3 ± 0.4	0.6 ± 0.5	
LALQAM (n=15)	5.4 ± 0.8	0.3 ± 0.1	0 ± 0	3.8 ± 0.2	23.3 ± 1.4	32.7 ± 1	0.5 ± 0.2	3.8 ± 0.3	1 ± 0.4	0.1 ± 0	0.8 ± 0	0.7 ± 0.1	1.5 ± 0.9	0.4 ± 0.2	3.5 ± 0.8	1.5 ± 0.2	6.4 ± 1.4	8 ± 1.3	0.3 ± 0	0 ± 0	0.9 ± 0.3	2.9 ± 0.7	0 ± 0	1.6 ± 0.4	0.3 ± 0.1	
LALQDS (n=14)	5 ± 0.1	0.3 ± 0	0 ± 0	3.2 ± 0.4	29.1 ± 2.4	35.7 ± 1.1	0.6 ± 0.1	6.2 ± 0.6	1 ± 0.2	0.2 ± 0	0.8 ± 0.1	0.5 ± 0.2	0.4 ± 0.2	0.2 ± 0.1	1.5 ± 0.5	1 ± 0.2	2.4 ± 0.6	6.7 ± 0.7	0.3 ± 0	0 ± 0	0.7 ± 0.1	2.7 ± 0.3	0 ± 0	1 ± 0.2	0.3 ± 0.1	
LALRCQ (n=14)	5.1 ± 0.1	0.3 ± 0	0 ± 0	4 ± 0.5	23 ± 1.1	33.2 ± 1.2	1 ± 0.2	3.5 ± 0.5	2.3 ± 0.2	0.2 ± 0	0.8 ± 0.1	0.6 ± 0	0.2 ± 0.1	0 ± 0	5.1 ± 1.6	1.7 ± 0.4	4.1 ± 0.7	6.6 ± 0.9	0.3 ± 0	0 ± 0	1.9 ± 0.3	2.8 ± 0.4	0 ± 0	1.8 ± 0.3	1.1 ± 0.4	
LALWKF (n=14)	5.3 ± 0.1	0.3 ± 0.1	0 ± 0	3.7 ± 0.3	26.7 ± 6.7	27.6 ± 3.6	1.3 ± 0.4	3.3 ± 0.3	2.2 ± 0.7	0.3 ± 0.1	0.8 ± 0	0.7 ± 0.1	0.6 ± 0.5	0.2 ± 0.2	2.1 ± 0.5	0.9 ± 0.3	9.3 ± 2.7	8.8 ± 1.5	0.3 ± 0.1	0 ± 0	0.7 ± 0.3	2.9 ± 0.6	0 ± 0	1.6 ± 0.5	0.1 ± 0.1	
LAMABL (n=8)	4.8 ± 0.2	0.3 ± 0	0 ± 0	3.3 ± 0.5	27.8 ± 6.3	30 ± 3.8	1.4 ± 0.2	3.7 ± 0.5	2.7 ± 0.7	0.4 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.3 ± 0.1	0 ± 0	1.3 ± 0.4	0.6 ± 0.1	7 ± 0.8	8.6 ± 1.7	0.3 ± 0	0 ± 0	1.3 ± 0.3	3.2 ± 0.4	0 ± 0	1.4 ± 0.3	0.1 ± 0.1	
LAMCKI (n=10)	5.1 ± 0.1	0.2 ± 0	0 ± 0	3.5 ± 0.2	26.4 ± 0.7	33.8 ± 0.5	1.1 ± 0	4.2 ± 0.2	1.8 ± 0.2	0.2 ± 0	0.8 ± 0	0.6 ± 0	0.1 ± 0	0 ± 0	3.9 ± 0.6	1.7 ± 0.2	2.9 ± 0.2	6.8 ± 0.6	0.3 ± 0	0 ± 0	1.2 ± 0.1	2.7 ± 0.3	0 ± 0	1.3 ± 0.1	0.9 ± 0.1	
LAMCLE (n=14)	4.9 ± 0.2	0.2 ± 0.1	0 ± 0	3.4 ± 0.2	25.1 ± 2.4	32.2 ± 1.6	1.1 ± 0.3	3.5 ± 0.3	2.4 ± 0.6	0.3 ± 0.1	0.8 ± 0	0.7 ± 0.1	0.4 ± 0.2	0 ± 0.1	2.3 ± 0.5	1 ± 0.2	5.8 ± 1.3	8.4 ± 1.3	0.1 ± 0.1	0 ± 0	1.8 ± 0.4	3.4 ± 0.6	0 ± 0	1.8 ± 0.5	0.1 ± 0.2	
LAMCLF (n=9)	5.1 ± 0.1	0.3 ± 0	0 ± 0	3.6 ± 0.1	24.7 ± 3.5	28.5 ± 2	1.1 ± 0.6	2.8 ± 0.5	2 ± 0.6	0.2 ± 0.1	0.8 ± 0	0.6 ± 0.1	1.4 ± 0.7	0.1 ± 0.1	2.8 ± 0.7	1 ± 0.2	9.7 ± 2.2	9.4 ± 1	0.3 ± 0	0 ± 0	1 ± 0.3	2.8 ± 0.5	0 ± 0	1.5 ± 0.3	0 ± 0.1	
LAMEUB (n=15)	5 ± 0.2	0.3 ± 0.1	0 ± 0	3.8 ± 0.5	28.4 ± 5.6	29.7 ± 2.1	0.9 ± 0.3	3.4 ± 0.6	1.3 ± 0.4	0.1 ± 0.1	0.9 ± 0.1	0.8 ± 0.1	1 ± 0.4	0.2 ± 0.1	2.7 ± 0.3	1.1 ± 0.3	8.4 ± 2.9	7.6 ± 1.9	0.3 ± 0	0 ± 0	0.5 ± 0.2	2.2 ± 0.7	0 ± 0	1.2 ± 0.5	0.1 ± 0.1	
LAMEUU (n=13)	5 ± 0.1	0.1 ± 0.1	0 ± 0	3.3 ± 0.4	25.8 ± 4.8	34.3 ± 1.8	1.4 ± 0.3	4.2 ± 0.7	2.1 ± 0.4	0.2 ± 0.1	0.9 ± 0.1	0.7 ± 0.1	0.2 ± 0.2	1.8 ± 1.8	1.4 ± 1.5	1.2 ± 0.3	3.1 ± 0.8	7.8 ± 1.1	0.2 ± 0.2	0 ± 0	1.4 ± 0.2	3 ± 0.4	0 ± 0	1.5 ± 0.3	0.3 ± 0.3	
LAMFJO (n=15)	5.1 ± 0.7	0.2 ± 0.1	0 ± 0	3.5 ± 0.7	26.5 ± 1.9	32.9 ± 0.8	0.2 ± 0.1	4.5 ± 0.4	0.4 ± 0.1	0 ± 0	0.9 ± 0.1	1 ± 0.1	2.2 ± 0.7	1.7 ± 1.9	3.7 ± 0.6	2 ± 0.3	4.7 ± 1.8	6.2 ± 0.7	0.3 ± 0.1	0 ± 0	0.3 ± 0.2	2.2 ± 0.3	0 ± 0.1	1 ± 0.2	0.4 ± 0.3	

LAMIRY (n=10)	5 ± 0.2	0.3 ± 0	0 ± 0	3.5 ± 0.3	26.9 ± 6.8	30.9 ± 2.8	0.6 ± 0.1	4.6 ± 0.5	1.2 ± 0.3	0.2 ± 0	0.8 ± 0	0.7 ± 0.2	1.1 ± 0.2	0.4 ± 0.1	2.4 ± 0.4	1.4 ± 0.3	4.5 ± 0.9	9.1 ± 2.1	0.3 ± 0	0 ± 0	1 ± 0.2	3 ± 0.6	0 ± 0	1.6 ± 0.4	0.5 ± 0.1	
LAMJIC (n=9)	5.8 ± 0.4	0.2 ± 0.1	0 ± 0	3.1 ± 0.5	28.5 ± 6.6	33.1 ± 3.9	0.6 ± 0.2	5.3 ± 1.2	1.3 ± 0.6	0.2 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.5 ± 0.3	0.1 ± 0.1	2.6 ± 0.4	1.3 ± 0.3	3.9 ± 1.3	6.2 ± 1.8	0.3 ± 0.1	0 ± 0	0.9 ± 0.3	2.6 ± 1	0 ± 0	1.4 ± 0.4	0.4 ± 0.1	
LAMPJB (n=13)	4.8 ± 0.1	0.1 ± 0	0 ± 0	3.1 ± 0.3	24.1 ± 1.7	33.6 ± 0.9	0.9 ± 0.2	3.7 ± 0.5	2.2 ± 0.5	0.3 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.4 ± 0.3	0 ± 0	2.8 ± 0.4	1.2 ± 0.2	5.5 ± 2.2	8.7 ± 1	0 ± 0.1	0 ± 0	1.5 ± 0.3	3.2 ± 0.4	0 ± 0	2 ± 0.3	0.1 ± 0.3	
LAMQDL (n=14)	5 ± 0.5	0.2 ± 0	0 ± 0	2.7 ± 0.4	26.4 ± 2.2	31.2 ± 1	0.2 ± 0	5.2 ± 0.6	0.4 ± 0.1	0.1 ± 0	0.7 ± 0.1	1 ± 0.1	2.8 ± 0.5	1 ± 0.2	3.7 ± 0.4	2.1 ± 0.4	4.7 ± 2	6.7 ± 1.2	0.3 ± 0	0 ± 0	0.4 ± 0.1	2.7 ± 0.7	0 ± 0	0.8 ± 0.2	0.4 ± 0.2	1.1 ± 0.1
LAMQNE (n=14)	6.9 ± 1.3	0.3 ± 0.1	0 ± 0	2.7 ± 0.3	27.8 ± 2.6	31.8 ± 0.7	0.8 ± 0.1	4.9 ± 0.6	1.3 ± 0.1	0.2 ± 0	0.7 ± 0.1	0.7 ± 0.1	0.4 ± 0.1	0.2 ± 0.1	4 ± 1.7	1.9 ± 0.8	2.7 ± 1	5.9 ± 1.1	0.3 ± 0	0 ± 0	1.2 ± 0.2	2.8 ± 0.6	0 ± 0	1.2 ± 0.3	0.8 ± 0.6	0.4 ± 0.1
LAMQSF (n=14)	5.2 ± 0.1	0.3 ± 0	0 ± 0	3.4 ± 0.3	24.3 ± 2.7	31.5 ± 1.2	0.8 ± 0.4	4.5 ± 0.7	2 ± 0.8	0.3 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.6 ± 0.2	0.2 ± 0.2	1.9 ± 0.6	1.3 ± 0.5	4.1 ± 1.5	10.6 ± 1.7	0.3 ± 0	0 ± 0	1.1 ± 0.2	3.6 ± 0.5	0 ± 0	1.8 ± 0.5	0.3 ± 0.3	
LAMRCO (n=14)	5.5 ± 0.6	0.3 ± 0.1	0 ± 0	4.4 ± 0.6	23.9 ± 6.8	28.4 ± 3.1	1.3 ± 0.4	2.7 ± 0.4	3.4 ± 0.8	0.3 ± 0.1	1 ± 0.2	0.6 ± 0.1	0.4 ± 0.2	0.1 ± 0.1	3.7 ± 0.8	1.3 ± 0.3	5.7 ± 1.3	8.7 ± 1.7	0.4 ± 0.1	0 ± 0	1.8 ± 0.4	3.3 ± 0.8	0 ± 0	2.1 ± 0.6	0.4 ± 0.2	0.4 ± 0.1
LAMRDS (n=15)	4.8 ± 0.1	0 ± 0	0 ± 0	3.6 ± 0.4	23.4 ± 1.7	32.7 ± 1.3	1.1 ± 0.2	3.4 ± 0.5	2.3 ± 0.3	0.2 ± 0	0.9 ± 0.1	0.7 ± 0	0.2 ± 0.1	5.4 ± 0.9	0 ± 0.1	1.2 ± 0.1	3.4 ± 0.8	8.2 ± 0.7	0.4 ± 0.1	0 ± 0	2 ± 0.4	3.5 ± 0.3	0 ± 0	1.8 ± 0.3	0.5 ± 0.3	
LAMRHL (n=14)	6 ± 1	0.3 ± 0.1	0 ± 0	3.5 ± 0.5	26.5 ± 6	26.2 ± 3.9	0.6 ± 0.1	3.7 ± 0.8	1 ± 0.3	0.2 ± 0.1	0.9 ± 0.1	0.8 ± 0.2	1.6 ± 0.6	0.4 ± 0.1	3 ± 0.6	1.9 ± 0.4	4.6 ± 0.8	10.5 ± 1.9	0.4 ± 0	0 ± 0	1 ± 0.3	3.9 ± 1	0 ± 0	1.9 ± 0.5	0.3 ± 0.2	1.4 ± 0.4
LAMRJK (n=15)	4.9 ± 0.2	0.1 ± 0	0 ± 0	3.6 ± 0.4	26.4 ± 2.9	33 ± 1	1 ± 0.2	4.1 ± 0.6	2 ± 0.4	0.2 ± 0.1	0.9 ± 0.1	0.7 ± 0.1	0 ± 0.1	0.5 ± 1.4	2.6 ± 1.4	1.3 ± 0.3	4.4 ± 1.3	7.7 ± 1.2	0.1 ± 0.2	0 ± 0	1.3 ± 0.4	3.2 ± 0.6	0 ± 0	1.5 ± 0.2	0.2 ± 0.4	
LAMRNQ (n=9)	4.8 ± 0.1	0.2 ± 0	0 ± 0	2.7 ± 0.4	29.6 ± 3.8	32.2 ± 0.9	0.5 ± 0.1	5.1 ± 0.8	0.9 ± 0.2	0.1 ± 0	0.8 ± 0.1	0.9 ± 0	1.2 ± 0.2	0.3 ± 0.1	2.8 ± 0.7	1.3 ± 0.3	4.6 ± 1.3	6 ± 1.2	0.3 ± 0	0 ± 0	0.9 ± 0.1	2.4 ± 0.3	0 ± 0	1.2 ± 0.3	0.4 ± 0.2	0.6 ± 0.2
LAMVUB (n=15)	4.9 ± 0.3	0.2 ± 0	0 ± 0	3.6 ± 0.4	24.6 ± 1.9	33.4 ± 0.5	0.2 ± 0.1	4.8 ± 0.4	0.4 ± 0.1	0 ± 0	0.9 ± 0.1	1 ± 0.1	2.8 ± 0.5	1 ± 0.2	4 ± 0.4	2.4 ± 0.3	4 ± 1.4	6.7 ± 1	0.4 ± 0	0 ± 0	0.5 ± 0.1	2.3 ± 0.4	0 ± 0	1.3 ± 0.3	0.6 ± 0.2	
LAMYDP (n=14)	5.1 ± 0.5	0.2 ± 0.1	0 ± 0	4 ± 0.8	23.1 ± 2.3	31.7 ± 1.1	1.2 ± 0.1	4.1 ± 0.5	2.4 ± 0.3	0.3 ± 0	0.9 ± 0.1	0.6 ± 0	0.3 ± 0.1	0 ± 0	2.5 ± 0.4	1.3 ± 0.3	4.1 ± 0.8	10.3 ± 1.6	0.3 ± 0.1	0 ± 0	1.3 ± 0.3	3.6 ± 0.7	0 ± 0	2.1 ± 0.5	0.4 ± 0.2	
LANBCH (n=14)	4.7 ± 0.8	0.2 ± 0.1	0 ± 0	3.4 ± 0.4	25 ± 3.9	32.7 ± 1.5	0.8 ± 0.2	4.7 ± 0.5	1.5 ± 0.5	0.2 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.5 ± 0.2	0.2 ± 0.1	2.3 ± 0.4	1.5 ± 0.2	3.5 ± 0.5	9.2 ± 1.8	0.3 ± 0	0 ± 0	1.3 ± 0.4	3.7 ± 0.9	0 ± 0	2 ± 0.6	0.5 ± 0.1	0.3 ± 0
LANCEG (n=4)	4.9 ± 0.1	0.1 ± 0.1	0 ± 0	3.3 ± 0.2	23.8 ± 1.2	33.2 ± 0.5	0.9 ± 0.1	3.7 ± 0.4	2 ± 0.3	0.3 ± 0	0.8 ± 0	0.7 ± 0	0.2 ± 0.1	5.5 ± 0.2	0.2 ± 0.1	0.7 ± 0.1	1.5 ± 0.4	10.8 ± 0.4	0.3 ± 0.1	0 ± 0	1.2 ± 0.1	3.8 ± 0.2	0 ± 0	1.7 ± 0.2	0 ± 0	
LANCOX (n=10)	5.1 ± 0.7	0.2 ± 0.1	0 ± 0	3.1 ± 0.2	25 ± 2.5	35.5 ± 1.3	0.7 ± 0.1	4.1 ± 0.3	2.1 ± 0.3	0.3 ± 0	0.8 ± 0.1	0.7 ± 0	0 ± 0	7.2 ± 2.4	0.2 ± 0.1	0.6 ± 0.1	1.6 ± 0.3	7.3 ± 1.5	0.3 ± 0.1	0 ± 0	0.9 ± 0.4	2.7 ± 0.7	0 ± 0.1	1.4 ± 0.5	0 ± 0	
LANFEF (n=15)	5.1 ± 0.3	0.1 ± 0.1	0 ± 0	3.5 ± 0.4	27.2 ± 1	34.3 ± 1.1	0.2 ± 0.1	4.5 ± 0.9	0.3 ± 0	0 ± 0	0.8 ± 0.1	1 ± 0	2.5 ± 0.3	0.8 ± 0.2	3.5 ± 0.5	1.6 ± 0.4	3.3 ± 1.4	5.5 ± 0.5	0.2 ± 0.1	0 ± 0	1 ± 0.1	2.2 ± 0.3	0 ± 0	1.1 ± 0.1	0.8 ± 0.2	0.9 ± 0
LANMGC (n=15)	5.6 ± 0.9	0.2 ± 0.1	0 ± 0	4 ± 0.5	25.1 ± 1.9	33.1 ± 1.8	1 ± 0.2	4.3 ± 0.3	2.1 ± 0.2	0.2 ± 0	0.9 ± 0.1	0.7 ± 0	0.2 ± 0	0 ± 0	7.9 ± 1.3	3.6 ± 0.7	1.4 ± 0.5	3.7 ± 1.3	0.3 ± 0	0 ± 0	0.7 ± 0.2	1.5 ± 0.6	0 ± 0	0.8 ± 0.4	2.4 ± 0.6	
LANMOM (n=10)	5.4 ± 0.4	0.2 ± 0	0 ± 0	2.8 ± 0.2	26.9 ± 3.1	31.8 ± 1.3	0.8 ± 0.2	4.9 ± 0.5	1.4 ± 0.4	0.2 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.6 ± 0.3	0.2 ± 0.1	2 ± 0.3	1.2 ± 0.2	3.9 ± 0.5	8.6 ± 1.5	0.3 ± 0	0 ± 0	1.2 ± 0.2	3.7 ± 0.7	0 ± 0	1.5 ± 0.4	0.4 ± 0.1	0.3 ± 0.1
LANPMZ (n=13)	4.8 ± 0.6	0.2 ± 0.1	0 ± 0	3.7 ± 0.3	26.2 ± 1.4	34.4 ± 1	0.3 ± 0.1	5 ± 0.4	0.5 ± 0.1	0.1 ± 0	0.9 ± 0	0.9 ± 0.1	1.5 ± 0.3	0.5 ± 0.2	3 ± 0.2	2 ± 0.3	2.7 ± 0.3	6.9 ± 0.8	0.4 ± 0	0 ± 0	0.8 ± 0.2	2.8 ± 0.6	0 ± 0	1.5 ± 0.3	0.7 ± 0.1	1 ± 0.1

LANTLE (n=15)	5 ± 0.4	0.2 ± 0.1	0 ± 0	2.4 ± 0.4	26.7 ± 4	32.7 ± 1.2	0.4 ± 0.3	6.1 ± 0.8	1 ± 0.5	0.1 ± 0.1	0.6 ± 0.1	0.8 ± 0.2	1.4 ± 1	0.5 ± 0.5	2.5 ± 0.5	1.7 ± 0.4	3.9 ± 1.4	7.9 ± 1.9	0 ± 0.1	0 ± 0	0.7 ± 0.4	3.3 ± 0.8	0 ± 0	1.5 ± 0.4	0.1 ± 0.2	0.4 ± 0.2
LANTSP (n=12)	4.9 ± 0.2	0.2 ± 0	0.1 ± 0	3.3 ± 0.3	35.9 ± 6.9	26.8 ± 4	0.8 ± 0.2	4.6 ± 0.9	1.1 ± 0.4	0.2 ± 0.1	0.9 ± 0.1	0.9 ± 0.2	0.8 ± 0.3	0.2 ± 0.1	2.1 ± 0.4	1.2 ± 0.2	3.4 ± 0.9	6.6 ± 1.8	0.4 ± 0	0 ± 0	1 ± 0.4	2.5 ± 0.7	0 ± 0	1.3 ± 0.4	0.4 ± 0.2	0.4 ± 0.3
LANUCB (n=14)	5 ± 0.5	0.3 ± 0	0 ± 0	2.9 ± 0.4	28.2 ± 4.5	28.8 ± 2.2	1.5 ± 0.6	3.8 ± 0.8	2.7 ± 1.5	0.4 ± 0.3	0.7 ± 0.1	0.7 ± 0.1	0.5 ± 0.5	0.1 ± 0.1	2.2 ± 0.7	1.1 ± 0.3	5.7 ± 1.9	9.2 ± 1.4	0.2 ± 0.1	0 ± 0	0.9 ± 0.3	3.3 ± 0.5	0 ± 0	1.3 ± 0.4	0 ± 0.1	0.6 ± 0.5
LAOBGQ (n=15)	5.2 ± 0.4	0.2 ± 0.1	0 ± 0	3.5 ± 0.3	31.8 ± 7.9	29.2 ± 4.2	1.2 ± 0.4	3.9 ± 0.6	2.5 ± 0.7	0.4 ± 0.2	0.8 ± 0.1	0.7 ± 0.1	0.2 ± 0.2	0 ± 0	2.1 ± 0.9	1.1 ± 0.5	3.9 ± 0.6	7.3 ± 1.5	0.2 ± 0.2	0 ± 0	1.1 ± 0.3	2.9 ± 0.6	0 ± 0	1.4 ± 0.4	0.1 ± 0.3	0.1 ± 0.1
LAOHLR (n=14)	5.1 ± 0.2	0.2 ± 0	0 ± 0	3.5 ± 0.3	26.5 ± 6.1	33 ± 2.7	1.1 ± 0.2	3.7 ± 0.7	2.1 ± 0.4	0.2 ± 0	0.9 ± 0.1	0.7 ± 0.1	0.1 ± 0.1	0 ± 0	4.1 ± 1.6	1.4 ± 0.5	5.3 ± 0.8	6.8 ± 1.2	0.3 ± 0.1	0 ± 0	0.8 ± 0.2	2.3 ± 0.4	0 ± 0	1.2 ± 0.3	0.3 ± 0.3	
LAOJAT (n=15)	5.1 ± 0.5	0.1 ± 0.1	0 ± 0	2.8 ± 0.7	28.7 ± 4	34 ± 1.8	0.6 ± 0.1	5 ± 0.8	1.3 ± 0.4	0.1 ± 0.1	0.6 ± 0.1	0.8 ± 0.1	0.7 ± 0.4	0.1 ± 0.2	1.5 ± 0.5	0.9 ± 0.2	4.3 ± 0.7	7.9 ± 1.3	0 ± 0	0 ± 0	0.8 ± 0.3	2.9 ± 0.4	0 ± 0	1.4 ± 0.3	0 ± 0	0.3 ± 0.1
LAOKLP (n=15)	4.7 ± 0.4	0.2 ± 0	0 ± 0	3.1 ± 0.2	26 ± 2.2	32.5 ± 1.3	0.2 ± 0	5.2 ± 0.5	0.3 ± 0	0 ± 0	0.8 ± 0	1 ± 0	2.5 ± 0.7	1 ± 0.2	3.5 ± 0.4	2.1 ± 0.3	4.4 ± 1.6	6.5 ± 0.9	0.3 ± 0	0 ± 0	0.5 ± 0.1	2.5 ± 0.6	0 ± 0	1.2 ± 0.3	0.5 ± 0.2	1.1 ± 0.6
LAOKTE (n=15)	4.7 ± 0.3	0.2 ± 0.1	0.1 ± 0	2.8 ± 0.4	27.1 ± 7.8	31.4 ± 2.3	0.5 ± 0.3	5.5 ± 1.7	0.9 ± 0.6	0.1 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	1.2 ± 0.7	0.4 ± 0.2	2.5 ± 0.8	1.6 ± 0.4	4.1 ± 2.2	8.2 ± 2.9	0.3 ± 0.1	0 ± 0	0.9 ± 0.4	3.3 ± 1	0 ± 0	1.6 ± 0.6	0.4 ± 0.2	0.5 ± 0.2
LAPKLS (n=12)	5.2 ± 0.3	0.2 ± 0.1	0 ± 0	3.7 ± 0.5	23.8 ± 1.9	33.6 ± 0.7	0.9 ± 0.1	4.1 ± 0.5	1.9 ± 0.4	0.2 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.4 ± 0.3	0.1 ± 0.1	3.1 ± 0.5	1.5 ± 0.4	6 ± 2.3	7.9 ± 1.5	0.2 ± 0.1	0 ± 0	0.8 ± 0.3	2.6 ± 0.7	0 ± 0	1.4 ± 0.5	0.3 ± 0.3	0.4 ± 0.2
LAPKXM (n=15)	4.6 ± 0.3	0.2 ± 0	0 ± 0	3.2 ± 0.3	26.1 ± 2	32 ± 0.9	0.7 ± 0.2	5.2 ± 0.5	1.2 ± 0.4	0.2 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.9 ± 0.7	0.3 ± 0.3	2.3 ± 0.4	1.7 ± 0.2	3.1 ± 0.7	9.8 ± 2	0.3 ± 0	0 ± 0	0.9 ± 0.3	3.4 ± 0.7	0 ± 0	1.4 ± 0.4	0.4 ± 0.3	0.5 ± 0.2
LAPKZJ (n=15)	5.1 ± 0.5	0.1 ± 0.1	0 ± 0	3.6 ± 0.4	24.6 ± 1.9	31.8 ± 1.6	0.4 ± 0.2	4.7 ± 0.7	0.6 ± 0.3	0 ± 0	0.8 ± 0.1	0.9 ± 0.2	2.1 ± 0.8	0.8 ± 0.4	3.4 ± 0.5	2.1 ± 0.5	4.9 ± 2.1	7.7 ± 1.1	0.2 ± 0.2	0 ± 0	0.6 ± 0.3	2.8 ± 0.5	0 ± 0	1.4 ± 0.3	0.4 ± 0.5	1 ± 0.2
LAPWJD (n=14)	5.1 ± 0.4	0.1 ± 0.1	0 ± 0	3.6 ± 0.1	27 ± 0.9	34 ± 0.7	0.3 ± 0.1	4.9 ± 0.2	0.5 ± 0.1	0 ± 0	0.8 ± 0.1	0.9 ± 0.1	1.6 ± 0.4	0.6 ± 0.2	3.4 ± 0.2	2.2 ± 0.2	2.5 ± 0.3	6.2 ± 0.3	0.2 ± 0.2	0 ± 0	0.7 ± 0.1	2.5 ± 0.2	0 ± 0	1.3 ± 0.1	0.7 ± 0.1	0.8 ± 0.1
LAPWLP (n=14)	4.5 ± 0.4	0.2 ± 0	0 ± 0	3 ± 0.3	32.5 ± 6.3	23.1 ± 3.7	0.5 ± 0.3	5.1 ± 0.8	0.5 ± 0.3	0.1 ± 0.1	0.8 ± 0.1	1.2 ± 0.2	2.5 ± 0.9	0.9 ± 0.4	2.2 ± 0.4	1.8 ± 0.4	3.5 ± 0.7	10 ± 2.3	0.3 ± 0	0 ± 0	0.7 ± 0.2	3.6 ± 1	0 ± 0	1.7 ± 0.6	0.2 ± 0.2	1.3 ± 0.4
LAQYTA (n=15)	5.6 ± 0.2	0 ± 0	0 ± 0	3.3 ± 0.3	24.7 ± 1.3	31.5 ± 1.3	1.3 ± 0.2	4.1 ± 0.5	2.1 ± 0.3	0.1 ± 0.1	0.7 ± 0.1	0.6 ± 0	0.2 ± 0.2	0 ± 0	3.6 ± 1.6	1.6 ± 0.8	5.8 ± 2.6	8.2 ± 1.4	0 ± 0	0 ± 0	1 ± 0.2	2.9 ± 0.5	0 ± 0	1.4 ± 0.3	0.5 ± 0.7	0.5 ± 0.2
LAQYUT (n=15)	5.5 ± 0.3	0.2 ± 0	0 ± 0	3.3 ± 0.3	26.6 ± 4	33.4 ± 1.5	1 ± 0.2	4 ± 0.6	2.2 ± 0.5	0.2 ± 0.1	0.7 ± 0.1	0.6 ± 0.1	0.1 ± 0.1	0 ± 0	3.7 ± 2.1	1.5 ± 0.8	4.1 ± 1.4	7.1 ± 1.5	0.1 ± 0.1	0 ± 0	1.1 ± 0.2	2.4 ± 0.5	0 ± 0	1.3 ± 0.3	0.5 ± 0.6	0.2 ± 0.2
LAQYWQ (n=15)	5.6 ± 0.2	0.2 ± 0.1	0 ± 0	3.9 ± 0.5	26.9 ± 6	30.3 ± 2.1	1.3 ± 0.4	4.1 ± 0.6	2.5 ± 0.8	0.3 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.2 ± 0.2	0 ± 0	2.3 ± 1.1	1.1 ± 0.6	6.5 ± 3	7.9 ± 2	0.1 ± 0.1	0 ± 0	0.8 ± 0.4	2.5 ± 0.7	0 ± 0	1.4 ± 0.6	0.2 ± 0.4	0.2 ± 0.2
LAQZME (n=12)	5.3 ± 0.7	0.2 ± 0.1	0 ± 0	2.5 ± 0.2	33.3 ± 6.9	24.1 ± 4.6	0.5 ± 0.1	4.1 ± 0.5	0.9 ± 1	0.2 ± 0.1	0.7 ± 0.1	1.1 ± 0.4	1.3 ± 1.1	0.6 ± 0.3	2.7 ± 0.2	1.8 ± 0.3	5.6 ± 0.5	8.2 ± 1.2	0.3 ± 0	0 ± 0	0.7 ± 0.3	3 ± 0.5	0 ± 0	1.6 ± 0.6	0.1 ± 0.1	1.4 ± 1.1

Table 43: Fatty acid profiles of one T2 seed batch per event harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T2 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LALHCY (n=1)	7.6	1.1	0.7	2.3	19.7	25.6	0.9	6.3	3.6	0.7	0.8	0.6	0.0	0.0	1.2	1.1	3.9	10.4	0.0	0.0	1.0	7.0	0.0	3.4	0.0	0.0
LALIAO (n=1)	5.1	0.2	0.0	3.1	23.3	31.4	0.8	4.2	1.4	0.2	0.8	0.7	0.7	0.1	2.4	1.5	5.7	13.2	0.4	0.0	0.6	2.7	0.0	1.1	0.0	0.4
LALJKA (n=1)	5.6	0.3	0.0	2.1	22.4	34.6	0.5	6.2	2.6	0.6	0.6	0.6	0.2	0.1	1.0	0.7	2.9	9.4	0.3	0.0	1.6	4.9	0.0	2.3	0.4	
LALLTL (n=1)	5.4	0.3	0.0	3.6	24.5	31.8	0.9	5.0	1.7	0.3	0.8	0.0	0.3	0.2	2.8	1.9	2.8	8.6	0.3	0.0	1.7	3.7	0.0	2.2	1.1	
LALQAM (n=1)	7.1	0.5	0.0	3.9	21.1	30.2	0.8	4.0	1.7	0.2	0.8	0.5	0.5	0.2	2.3	1.2	6.2	10.4	0.3	0.0	1.3	4.3	0.0	2.2	0.3	0.0
LALQDS (n=1)	5.3	0.3	0.0	3.4	25.3	35.7	0.7	6.1	1.4	0.3	0.8	0.0	0.3	0.2	1.6	1.2	2.4	8.3	0.4	0.0	0.9	3.4	0.0	1.5	0.4	0.0
LALRCQ (n=1)	5.0	0.3	0.0	3.6	23.0	32.7	1.0	4.0	2.3	0.3	0.8	0.6	0.3	0.1	3.5	1.5	3.8	8.4	0.3	0.0	2.0	3.5	0.0	2.1	0.9	0.0
LALWKF (n=1)	5.5	0.3	0.0	3.7	23.0	29.0	1.4	3.4	2.9	0.4	0.8	0.6	0.3	0.1	1.9	1.2	5.9	11.3	0.3	0.0	1.2	3.9	0.0	2.4	0.2	0.0
LAMABL (n=1)	4.6	0.3	0.0	3.7	24.3	31.5	1.4	3.4	2.8	0.3	0.9	0.6	0.2	0.0	1.1	0.6	7.3	10.1	0.3	0.0	1.2	3.6	0.0	1.5	0.0	0.0
LAMCKI (n=1)	5.1	0.2	0.0	3.4	25.6	33.0	1.1	4.2	2.0	0.3	0.8	0.6	0.1	0.0	3.9	1.8	3.1	7.7	0.3	0.0	1.3	3.0	0.0	1.5	0.9	
LAMCLE (n=1)	4.8	0.2	0.0	3.9	22.2	31.9	1.3	3.3	3.1	0.4	0.9	0.6	0.0	0.0	2.0	1.1	3.8	10.5	0.0	0.0	2.8	4.3	0.0	2.8	0.0	0.0
LAMCLF (n=1)	5.2	0.3	0.0	3.8	24.0	27.7	1.7	3.1	3.1	0.3	0.8	0.5	0.7	0.0	1.9	0.9	7.5	11.2	0.3	0.0	1.3	3.6	0.0	1.9	0.2	0.0
LAMEUB (n=1)	5.4	0.4	0.0	4.7	26.2	27.5	1.0	3.4	1.5	0.2	1.0	0.7	1.2	0.3	2.6	1.8	3.8	11.1	0.3	0.0	0.8	3.6	0.0	2.2	0.3	0.0
LAMEUU (n=1)	10.9	1.2	1.0	2.9	16.4	27.3	0.0	8.4	2.3	0.7	1.0	0.7	0.0	0.0	1.1	0.7	4.5	6.6	0.3	0.0	1.4	6.3	0.0	4.5	0.0	0.0
LAMFJO (n=1)	5.5	0.4	0.0	2.4	26.8	30.6	0.2	7.3	0.4	0.1	0.6	0.8	2.1	1.0	1.7	1.4	2.8	7.4	0.2	0.0	0.9	4.5	0.0	1.8	0.5	0.5
LAMIRY (n=1)	5.1	0.3	0.0	3.7	23.0	30.3	0.7	4.5	1.4	0.2	0.8	0.7	1.1	0.3	2.4	1.6	4.4	11.6	0.3	0.0	1.1	3.7	0.0	2.0	0.5	0.0
LAMJIC (n=1)	6.3	0.3	0.0	2.9	24.5	28.3	0.7	6.4	1.3	0.3	0.7	0.7	0.7	0.2	2.7	1.7	4.9	9.4	0.3	0.0	1.1	4.3	0.0	1.8	0.5	0.0
LAMPJB (n=1)	4.9	0.2	0.0	3.2	24.2	32.0	1.1	4.0	2.7	0.4	0.8	0.7	0.0	0.0	2.2	1.1	4.0	10.3	0.0	0.0	1.8	4.0	0.0	2.4	0.0	0.0
LAMQDL (n=1)	4.3	0.2	0.0	2.4	24.7	28.5	0.2	6.1	0.5	0.1	0.8	1.1	2.6	1.4	3.6	2.9	2.5	9.4	0.4	0.0	0.7	4.7	0.0	1.3	0.8	1.1
LAMQNE (n=1)	7.6	0.4	0.0	2.7	25.4	30.7	0.7	4.7	1.4	0.2	0.7	0.6	0.5	0.2	3.0	1.5	3.6	7.8	0.3	0.0	1.4	3.7	0.0	1.7	0.8	0.3
LAMQSF (n=1)	5.4	0.3	0.0	3.8	20.3	30.2	0.5	3.9	3.6	0.5	0.8	0.6	0.4	0.1	1.3	0.9	6.1	13.3	0.3	0.0	1.0	4.0	0.0	2.4	0.0	0.0
LAMRCO (n=1)	6.7	0.4	0.0	4.2	14.8	26.6	1.0	2.4	4.7	0.5	1.0	0.4	0.3	0.0	3.9	1.5	6.7	12.3	0.4	0.0	2.6	5.3	0.0	3.5	0.5	0.0
LAMRDS (n=1)	4.9	0.0	0.0	3.4	20.9	31.3	1.4	2.7	2.7	0.2	0.9	0.6	0.3	6.6	0.0	1.2	4.0	9.1	0.3	0.0	2.7	3.8	0.0	2.1	0.7	0.0
LAMRHL (n=1)	6.4	0.3	0.0	4.0	19.7	23.4	0.8	2.6	1.1	0.2	1.0	0.7	1.9	0.5	4.4	2.7	4.7	13.7	0.3	0.0	1.3	5.0	0.0	2.8	0.6	1.8
LAMRJK (n=1)	5.0	0.2	0.0	3.6	25.5	31.1	1.5	4.3	2.6	0.4	0.9	0.7	0.0	0.0	2.8	1.4	4.0	9.5	0.0	0.0	1.3	3.8	0.0	1.7	0.0	
LAMRNQ (n=1)	5.0	0.2	0.1	3.1	23.5	31.7	0.6	4.2	1.2	0.2	0.8	0.8	1.4	0.4	3.4	1.8	5.5	8.5	0.3	0.0	1.1	3.0	0.0	1.8	0.5	0.9
LAMVUB (n=1)	4.3	0.2	0.0	3.2	21.9	33.5	0.2	4.8	0.4	0.1	0.8	1.0	3.0	1.2	3.7	2.4	4.7	8.4	0.3	0.0	0.6	3.0	0.0	1.7	0.6	
LAMYDP (n=1)	3.4	0.1	0.0	2.9	19.2	29.9	1.1	4.6	2.8	0.4	0.7	0.7	0.4	0.1	2.0	1.5	4.2	14.1	0.3	0.0	1.9	5.7	0.0	3.3	0.5	0.2
LANBCH (n=1)	3.7	0.1	0.0	3.2	19.5	31.2	1.0	4.7	2.2	0.4	0.8	0.7	0.3	0.0	1.9	1.6	4.5	12.5	0.3	0.0	2.1	5.7	0.0	3.2	0.0	0.3

LANCEG (n=1)	5.0	0.0	0.0	3.7	22.4	33.6	0.8	4.1	2.0	0.3	0.9	0.6	0.1	5.5	0.4	0.7	1.3	11.2	0.2	0.0	1.2	4.0	0.0	2.0	0.0	0.0
LANCOX (n=1)	4.9	0.2	0.0	3.2	22.1	33.9	0.6	4.4	2.3	0.4	0.8	0.6	0.0	4.9	0.3	0.8	1.6	10.5	0.3	0.0	1.4	4.1	0.0	2.6	0.0	0.0
LANFEF (n=1)	5.3	0.0	0.0	2.5	28.8	32.0	0.0	6.0	0.3	0.0	0.6	1.0	2.7	1.1	2.7	1.6	2.4	6.3	0.0	0.0	1.0	2.9	0.0	1.1	0.9	0.8
LANMGC (n=1)	5.2	0.2	0.0	3.4	25.2	33.1	1.0	4.1	2.2	0.2	0.8	0.6	0.2	0.0	5.1	2.3	2.7	6.5	0.3	0.0	1.1	2.6	0.0	1.4	1.3	0.0
LANPMZ (n=1)	3.6	0.1	0.0	3.1	22.5	32.7	0.3	5.8	0.4	0.1	0.8	1.0	2.0	0.8	3.0	2.6	2.7	8.8	0.4	0.0	1.2	4.1	0.0	2.2	0.9	1.0
LANMOM (n=1)	5.3	0.2	0.0	2.8	19.6	32.5	0.8	4.5	2.2	0.4	0.7	0.6	0.4	0.2	2.3	1.6	4.3	11.9	0.3	0.0	1.5	4.6	0.0	2.5	0.4	0.3
LANTLE (n=1)	4.4	0.3	0.0	2.3	19.0	31.5	0.5	5.3	1.6	0.3	0.6	0.7	1.4	0.7	3.2	2.5	5.1	11.6	0.2	0.0	1.0	4.7	0.0	2.6	0.2	0.4
LANTSP (n=1)	5.3	0.2	0.0	2.9	23.5	32.1	0.8	4.6	1.9	0.3	0.7	0.7	0.4	0.1	2.3	1.5	3.6	9.9	0.3	0.0	1.8	3.9	0.0	2.3	0.6	0.1
LANUCB (n=1)	4.8	0.3	0.0	3.4	25.7	27.9	2.1	3.6	4.2	0.6	0.8	0.7	0.1	0.0	1.9	1.1	4.2	10.7	0.3	0.0	1.3	4.0	0.0	1.9	0.0	0.3
LAOBGQ (n=1)	4.8	0.2	0.0	3.4	23.0	34.0	0.9	3.9	2.0	0.2	0.9	0.7	0.4	0.0	2.4	1.2	4.8	9.2	0.4	0.0	1.6	3.8	0.0	1.9	0.0	0.2
LAOHLR (n=1)	5.5	0.2	0.0	3.2	21.7	34.5	1.1	3.2	2.3	0.2	0.8	0.6	0.0	0.0	4.6	1.6	6.0	8.4	0.3	0.0	1.1	2.6	0.0	1.6	0.3	0.0
LAOJAT (n=1)	5.3	0.2	0.0	2.9	22.5	34.1	0.8	5.0	2.3	0.4	0.6	0.6	0.4	0.0	2.1	1.3	4.3	10.3	0.0	0.0	1.0	3.6	0.0	2.0	0.0	0.2
LAOKLP (n=1)	5.0	0.2	0.0	3.1	22.9	32.5	0.2	5.5	0.4	0.1	0.8	1.0	3.0	1.3	3.2	2.5	3.4	8.4	0.3	0.0	0.7	3.3	0.0	1.8	0.6	0.0
LAOKTE (n=1)	4.9	0.2	0.0	2.6	21.3	29.8	0.9	4.6	1.9	0.3	0.7	0.6	0.3	0.2	2.3	1.6	5.4	12.6	0.3	0.0	1.4	4.8	0.0	2.4	0.4	0.3
LAPKLS (n=1)	5.7	0.3	0.0	3.8	20.0	32.5	1.1	3.9	3.0	0.4	0.8	0.6	0.0	0.0	3.1	2.0	4.0	10.6	0.2	0.0	1.4	3.5	0.0	2.3	0.6	0.1
LAPKXM (n=1)	4.4	0.2	0.0	3.6	23.0	33.1	0.8	4.3	1.7	0.2	0.9	0.7	0.5	0.0	2.3	1.6	4.3	13.3	0.4	0.0	0.6	2.5	0.0	1.2	0.0	0.3
LAPKZJ (n=1)	4.8	0.1	0.0	3.7	23.2	30.4	0.4	4.7	0.6	0.1	0.9	1.0	2.2	0.9	3.4	2.7	2.9	9.2	0.4	0.0	0.9	3.7	0.0	1.9	0.8	1.1
LAPWJD (n=1)	5.5	0.1	0.0	3.5	25.6	35.2	0.4	4.6	0.7	0.0	0.8	0.8	1.5	0.6	3.4	2.1	2.7	6.6	0.2	0.0	0.8	2.4	0.0	1.4	0.6	0.7
LAPWLP (n=1)	4.5	0.1	0.0	2.9	28.2	18.2	0.5	4.7	0.5	0.2	0.8	1.2	2.9	1.1	1.9	2.1	3.6	15.9	0.4	0.0	0.7	4.8	0.0	3.2	0.0	1.7
LAQYTA (n=1)	5.3	0.0	0.0	3.0	24.8	30.1	1.2	4.3	2.1	0.1	0.7	0.6	0.4	0.0	2.1	1.1	7.5	10.2	0.0	0.0	0.9	3.7	0.0	1.5	0.0	0.5
LAQYUT (n=1)	5.6	0.2	0.0	3.5	21.5	32.5	1.4	3.0	3.1	0.3	0.7	0.6	0.0	0.0	4.6	1.6	6.8	8.9	0.0	0.0	1.0	2.6	0.0	1.6	0.0	0.3
LAQYWQ (n=1)	5.8	0.3	0.0	4.3	22.3	30.0	2.1	3.6	4.1	0.6	0.8	0.5	0.3	0.0	1.7	1.1	3.8	11.5	0.0	0.0	1.5	3.5	0.0	1.9	0.0	0.1
LAQZME (n=1)	6.3	0.3	0.0	2.5	21.7	30.7	0.7	3.3	2.7	0.4	0.6	0.6	0.7	0.2	2.7	1.6	6.4	10.3	0.3	0.0	1.2	3.8	0.0	2.6	0.1	0.2

Table 44: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined in Table 41. The number of T1 plants fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=296)	4.9 ± 0.5	0.2 ± 0.1	0 ± 0	3.2 ± 0.6	28.5 ± 5.4	31 ± 4	0.5 ± 0.3	4.7 ± 1	0.8 ± 0.5	0.1 ± 0.1	0.8 ± 0.1	0.9 ± 0.2	1.6 ± 0.9	0.7 ± 1.2	2.7 ± 0.9	1.6 ± 0.6	4.6 ± 2.3	7.2 ± 1.9	0.3 ± 0.1	0 ± 0	0.7 ± 0.3	2.7 ± 0.7	0 ± 0	1.3 ± 0.4	0.3 ± 0.3	0.9 ± 0.5
dc (n=198)	5.1 ± 0.6	0.2 ± 0.1	0 ± 0	3.5 ± 0.6	23.7 ± 3.1	32.2 ± 2.5	1.1 ± 0.3	4.1 ± 0.7	2.3 ± 0.6	0.3 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.3 ± 0.2	0.4 ± 1.4	3 ± 2	1.6 ± 0.8	4 ± 1.8	9.1 ± 2.8	0.3 ± 0.1	0 ± 0	1.4 ± 0.5	3.4 ± 1.2	0 ± 0	1.8 ± 0.6	0.6 ± 0.7	0.3 ± 0.2
tc (n=2)	5.6 ± 0.4	0.3 ± 0	0 ± 0	4.4 ± 0.7	22 ± 1.5	30.2 ± 0.1	1.6 ± 0.7	3.6 ± 1.2	3.1 ± 0.7	0.4 ± 0.1	0.9 ± 0	0.6 ± 0	0.3 ± 0.1	0.1 ± 0.1	3.5 ± 1.5	1.7 ± 0.4	3.4 ± 1.1	9.7 ± 3	0.3 ± 0	0 ± 0	1.6 ± 0.2	3.6 ± 1.4	0 ± 0	2.2 ± 0.7	0.7 ± 0	

Table 45: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined in Table 41. For each category, the fatty acid profile of the plant having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	5.3	0.3	0.0	3.2	26.0	32.3	0.6	4.5	1.0	0.2	0.8	0.8	1.1	0.4	1.8	1.1	5.7	9.3	0.4	0.0	0.7	3.2	0.0	1.4	0.0	0.0
dc (n=1)	4.5	0.1	0.0	2.9	28.2	18.2	0.5	4.7	0.5	0.2	0.8	1.2	2.9	1.1	1.9	2.1	3.6	15.9	0.4	0.0	0.7	4.8	0.0	3.2	0.0	1.7
tc (n=1)	3.5	0.1	0.0	2.7	18.2	26.4	0.4	4.6	0.9	0.2	0.7	0.9	2.0	0.7	2.2	1.9	5.5	16.7	0.3	0.0	1.2	6.6	0.0	3.3	0.2	1.0

Table 46: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), NoI: number of lobes(#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
LALHCY (n=15)	59.3 ± 2.6	1 ± 0	1 ± 0	1 ± 0	1.3 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1.7 ± 1.1	4 ± 0	136 ± 3.9	4.7 ± 0.2	3.3 ± 1.1
LALIAO (n=15)	65.9 ± 3.2	1 ± 0	1.2 ± 0.8	1.3 ± 0.5	1.8 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1.3 ± 1.3	3.5 ± 0.9	124.3 ± 3.7	4 ± 0.5	3 ± 0.7
LALJKA (n=15)	62.1 ± 5.5	1 ± 0	1 ± 0	1.1 ± 0.3	2.5 ± 2.2	3 ± 0	3 ± 0	5 ± 0	1.6 ± 1.8	3.6 ± 0.7	126 ± 5.1	4.6 ± 0.2	3.4 ± 2
LALLTL (n=11)	55.3 ± 2.2	1 ± 0	1 ± 0	1 ± 0	1.5 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	4 ± 0	128.6 ± 5.5	4.5 ± 0.2	2.2 ± 1.2
LALQAM (n=15)	58.3 ± 2.8	1 ± 0	1 ± 0	1 ± 0	2.7 ± 2.1	3 ± 0	3 ± 0	5 ± 0	2.1 ± 2.3	4 ± 0	133.7 ± 4	4.8 ± 0.2	4.7 ± 1.8
LALQDS (n=14)	54.5 ± 3.1	1 ± 0	1 ± 0	1.6 ± 0.9	2.6 ± 1.8	3 ± 0	3 ± 0	5 ± 0	1.9 ± 1.6	4 ± 0	127.1 ± 5.4	4.6 ± 0.2	3.4 ± 1.4
LALRCQ (n=14)	61.7 ± 1.7	1 ± 0	1 ± 0	1 ± 0	2.1 ± 1.1	3 ± 0	3 ± 0	5 ± 0	1.9 ± 1.5	3.7 ± 0.7	127.1 ± 3.8	4.8 ± 0.3	3.3 ± 1.2
LALWKF (n=14)	62.1 ± 3.2	1 ± 0	1.4 ± 1.1	1 ± 0	1.4 ± 0.8	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	4 ± 0	132.9 ± 5.8	4.5 ± 0.2	3.1 ± 0.8
LAMABL (n=8)	56.1 ± 1.6	1 ± 0	2.9 ± 1.6	2.1 ± 0.6	6.5 ± 2	3 ± 0	3 ± 0	5 ± 0	5 ± 2.3	4 ± 0	123.1 ± 4.6	4.1 ± 0.4	5.3 ± 1.6
LAMCKI (n=10)	61.5 ± 2.4	1 ± 0	1 ± 0	1 ± 0	1.6 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	131 ± 3.9	4.1 ± 0.2	2.8 ± 0.6
LAMCLE (n=14)	65.4 ± 1.9	1 ± 0	1.4 ± 1.1	1.5 ± 0.8	2 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1.3 ± 0.6	3.7 ± 0.7	124.3 ± 4.3	4.3 ± 0.3	3 ± 1
LAMCLF (n=9)	66.4 ± 4.3	1 ± 0	1.3 ± 1	1 ± 0	1.1 ± 0.3	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.1 ± 1.1	121.1 ± 3.3	4 ± 0.5	2.1 ± 0.3
LAMEUB (n=15)	57.7 ± 2.4	1 ± 0	1 ± 0	1.5 ± 0.7	4.5 ± 2.3	3 ± 0	3 ± 0	5 ± 0	3.9 ± 2.3	4 ± 0	128.3 ± 3.6	4.2 ± 0.4	3.1 ± 1
LAMEUU (n=13)	65.8 ± 3.6	1 ± 0	1.5 ± 1.1	1.5 ± 0.9	2.2 ± 1.9	3 ± 0	3 ± 0	5 ± 0	2.1 ± 1.7	3.7 ± 0.8	126.2 ± 4.2	4.2 ± 0.4	3.2 ± 0.7
LAMFJO (n=15)	64.7 ± 2.9	1 ± 0	1.6 ± 1.2	1.1 ± 0.3	3.7 ± 2.4	3 ± 0	3 ± 0	5 ± 0	2.3 ± 1.7	4 ± 0	123.7 ± 3.5	4.1 ± 0.5	4.1 ± 2.4
LAMIRY (n=10)	54.7 ± 2.3	1 ± 0	1 ± 0	1 ± 0	2.2 ± 2.1	3 ± 0	3 ± 0	5 ± 0	1.6 ± 1.9	4 ± 0	123 ± 4.2	4.9 ± 0.2	3.3 ± 1.7
LAMJIC (n=9)	60.1 ± 2.9	1 ± 0	2 ± 1.5	2.7 ± 2.5	5.3 ± 3.1	3 ± 0	3 ± 0	5 ± 0	3.6 ± 2	3.3 ± 1	111.1 ± 26.8	3.9 ± 0.7	4.4 ± 1.1
LAMPJB (n=13)	64.8 ± 2.5	1 ± 0	1.1 ± 0.3	1 ± 0	2.1 ± 0.8	3 ± 0	3 ± 0	5 ± 0	1.5 ± 0.9	4 ± 0	123.5 ± 2.4	4.6 ± 0.3	3.8 ± 1.5
LAMQDL (n=14)	67.9 ± 4.5	1 ± 0	1.2 ± 0.8	1.6 ± 0.8	2.6 ± 2.3	3 ± 0	3 ± 0	5 ± 0	1.6 ± 0.9	4 ± 0	117.1 ± 6.4	3.5 ± 0.4	3.8 ± 1.6
LAMQNE (n=14)	71.9 ± 6.2	1 ± 0	1.2 ± 0.8	1 ± 0	1.5 ± 1.3	3 ± 0	3 ± 0	5 ± 0	1.1 ± 0.5	4 ± 0	119.3 ± 3.3	4.2 ± 0.3	3.6 ± 1.3
LAMQSF (n=14)	61.1 ± 1.8	1 ± 0	1 ± 0	1 ± 0	1.6 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1.1 ± 0.5	4 ± 0	123.9 ± 4	3.9 ± 0.5	2.6 ± 0.7
LAMRCO (n=14)	62.1 ± 2.9	1 ± 0	1 ± 0	1.6 ± 1	2.9 ± 1.7	3 ± 0	3 ± 0	5 ± 0	2.1 ± 1.3	4 ± 0	119.3 ± 4.3	3.9 ± 0.4	3.9 ± 2.1
LAMRDS (n=15)	63.7 ± 2.3	1 ± 0	1.4 ± 1.1	1.1 ± 0.3	1.9 ± 1.4	3 ± 0	3 ± 0	5 ± 0	1.4 ± 1.1	4 ± 0	125.7 ± 3.7	4.4 ± 0.4	2.7 ± 1.3
LAMRHL (n=14)	67.7 ± 4	1 ± 0	1 ± 0	1 ± 0	2.9 ± 2	3 ± 0	3 ± 0	5 ± 0	2.7 ± 2.4	4 ± 0	122.1 ± 2.6	4.1 ± 0.5	4.1 ± 1.1
LAMRJK (n=15)	63.4 ± 2.6	1 ± 0	1.3 ± 1	1 ± 0	3.5 ± 2	3 ± 0	3 ± 0	5 ± 0	2.5 ± 1.6	4 ± 0	124.7 ± 4.4	4.5 ± 0.4	3.8 ± 1.1
LAMRNQ (n=9)	63.1 ± 3	1 ± 0	1 ± 0	1 ± 0	1.1 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	121.9 ± 2.6	3.8 ± 0.5	2.6 ± 1.3

LAMVUB (n=15)	65.5 ± 3.3	1 ± 0	1 ± 0	1 ± 0	3.3 ± 2.6	3 ± 0	3 ± 0	5 ± 0	2.3 ± 1.9	4 ± 0	124.3 ± 4.2	4.6 ± 0.3	4.2 ± 2.2
LAMYDP (n=14)	64.1 ± 4.6	1 ± 0	1 ± 0	1 ± 0	1.9 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1.4 ± 0.9	4 ± 0	123.2 ± 3.7	4.5 ± 0.3	3.9 ± 1.4
LANBCH (n=14)	64.4 ± 2.8	1 ± 0	1 ± 0	1 ± 0	1.1 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	123.9 ± 3.5	4.2 ± 0.2	3.1 ± 0.7
LANCEG (n=4)	67.3 ± 3.3	1 ± 0	1 ± 0	1.3 ± 0.5	1.3 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	123.8 ± 2.5	4.1 ± 0.4	2.5 ± 0.6
LANCOX (n=10)	66.3 ± 3.2	1 ± 0	1 ± 0	1.6 ± 0.8	4.2 ± 2.3	3 ± 0	3 ± 0	5 ± 0	2.9 ± 1.4	3.6 ± 0.8	127.5 ± 2.6	4.6 ± 0.3	4 ± 1.5
LANFEF (n=15)	67.4 ± 2.4	1 ± 0	1.2 ± 0.8	1.1 ± 0.4	1.5 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1.1 ± 0.5	4 ± 0	127 ± 3.2	4.7 ± 0.3	2.9 ± 0.5
LANMGC (n=15)	64.2 ± 2	1 ± 0	1 ± 0	1 ± 0	2.3 ± 2.2	3 ± 0	3 ± 0	5 ± 0	1.7 ± 1.6	4 ± 0	123.7 ± 4	4.4 ± 0.3	3 ± 0.8
LANMOM (n=10)	65.9 ± 3.1	1 ± 0	1 ± 0	1 ± 0	1.4 ± 1	3 ± 0	3 ± 0	5 ± 0	1.1 ± 0.3	4 ± 0	119.5 ± 3.7	3.4 ± 0.7	3.3 ± 1.2
LANPMZ (n=13)	65.3 ± 3.1	1 ± 0	1 ± 0	1 ± 0	1.2 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	124.2 ± 3.4	4.4 ± 0.2	2.4 ± 0.5
LANTLE (n=15)	55.6 ± 2	1 ± 0	2.5 ± 1.7	3.1 ± 0.9	1.9 ± 1.8	3 ± 0	3 ± 0	5 ± 0	1.3 ± 0.6	3.9 ± 0.5	106 ± 9.3	3.2 ± 0.3	2.6 ± 0.8
LANTSP (n=12)	65.3 ± 3.4	1 ± 0	1 ± 0	1.2 ± 0.4	1.3 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	4 ± 0	124.6 ± 4	4.1 ± 0.4	3.8 ± 1.3
LANUCB (n=14)	58.3 ± 2.2	1 ± 0	1.2 ± 0.8	2.6 ± 0.6	1.9 ± 0.8	3 ± 0	3 ± 0	5 ± 0	1.4 ± 0.7	4 ± 0	117.9 ± 5.4	3.6 ± 0.3	3.1 ± 1
LAOBGQ (n=15)	67.8 ± 3.4	1 ± 0	1 ± 0	1.1 ± 0.4	1.2 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	127 ± 3.2	4.2 ± 0.3	3.1 ± 0.6
LAOHLR (n=14)	61.7 ± 2.7	1 ± 0	1 ± 0	1 ± 0	1.1 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.9 ± 0.5	123.2 ± 4.2	4.2 ± 0.5	2.8 ± 0.7
LAOJAT (n=15)	60.3 ± 2.8	1 ± 0	1 ± 0	1.4 ± 0.6	1.4 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	124.3 ± 5	4 ± 0.4	4.8 ± 1.6
LAOKLP (n=15)	62 ± 2.9	1 ± 0	1 ± 0	1.1 ± 0.4	1.9 ± 1.5	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	125.7 ± 3.2	4.1 ± 0.3	3.8 ± 1.9
LAOKTE (n=15)	62.9 ± 3.7	1 ± 0	1.4 ± 1.1	1.7 ± 0.6	2.1 ± 1.1	3 ± 0	3 ± 0	5 ± 0	1.3 ± 1	4 ± 0	122.3 ± 4.2	3.7 ± 0.5	5.6 ± 2.7
LAPKLS (n=12)	66.3 ± 2.7	1 ± 0	1 ± 0	1.7 ± 0.9	1.9 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	2.8 ± 1	118.3 ± 6.2	4.2 ± 0.3	4.5 ± 1.4
LAPKXM (n=15)	68.2 ± 3.2	1 ± 0	1.2 ± 0.8	1.9 ± 0.7	1.3 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.2 ± 1	127.3 ± 2.6	4 ± 0.4	3.5 ± 0.5
LAPKZJ (n=15)	67.9 ± 2.7	1 ± 0	1.2 ± 0.8	1.1 ± 0.3	1.5 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.9 ± 0.5	127 ± 3.2	4.2 ± 0.3	3.3 ± 0.8
LAPWJD (n=14)	68.3 ± 2.9	1 ± 0	1 ± 0	1.1 ± 0.4	1.7 ± 0.9	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	126.1 ± 4	4.6 ± 0.3	3.1 ± 0.3
LAPWLP (n=14)	64.9 ± 4	1 ± 0	1.5 ± 1.3	2 ± 1.4	3.6 ± 3	3 ± 0	3 ± 0	5 ± 0	2.6 ± 2.8	3.6 ± 0.9	119.3 ± 8.7	3.5 ± 0.4	4.1 ± 0.9
LAQYTA (n=15)	59.2 ± 3.9	1 ± 0	1.2 ± 0.8	2.6 ± 0.8	2.1 ± 1.5	3 ± 0	3 ± 0	5 ± 0	1.7 ± 1	3.7 ± 0.7	111.3 ± 6.1	3.6 ± 0.3	4.2 ± 1.3
LAQYUT (n=15)	66.3 ± 3	1 ± 0	1 ± 0	1.1 ± 0.3	1.6 ± 0.5	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.7 ± 0.7	126.3 ± 3	4.3 ± 0.2	3.7 ± 0.6
LAQYWQ (n=15)	66.7 ± 4.6	1 ± 0	1 ± 0	1.6 ± 0.7	2.5 ± 1.8	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	4 ± 0	124 ± 3.9	4.1 ± 0.4	3.8 ± 0.7
LAQZME (n=12)	64.3 ± 4.7	3 ± 3.6	1.8 ± 1.5	1.5 ± 0.5	4.1 ± 3.4	3 ± 0	3 ± 0	5 ± 0	2.8 ± 3.3	4 ± 0	124.2 ± 5.1	4.2 ± 0.4	4.8 ± 2.8

Table 47: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined in Table 41. The number of T1 plants fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Category of T1 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
sc (n=296)	62.9 ± 4.8	1 ± 0	1.2 ± 0.7	1.4 ± 0.9	2.5 ± 2	3 ± 0	3 ± 0	5 ± 0	1.7 ± 1.6	3.9 ± 0.4	123.9 ± 8	4.2 ± 0.6	3.6 ± 1.6
dc (n=198)	63.4 ± 4.5	1 ± 0.6	1.2 ± 0.7	1.2 ± 0.5	2 ± 1.6	3 ± 0	3 ± 0	5 ± 0	1.6 ± 1.4	3.8 ± 0.5	123.9 ± 10.4	4.2 ± 0.4	3.6 ± 1.6
tc (n=2)	59.5 ± 0.7	1 ± 0	1 ± 0	1 ± 0	1 ± 0	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	125 ± 0	3.7 ± 0.1	3.5 ± 0.7

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in greenhouses during summer

Table 48 shows the copy number analysis of select events. The events comprised one to two homozygous insertions and some had additional insertions still segregating. For example LANBCH segregated as homozygous for one T-DNA insertions for each construct, while LANPMZ segregated as homozygous for two T-DNA insertions for each construct. LALXOL seems to segregate for one insertion of VC-LLM337-1qcz rc, not homozygous, and for one homozygous insertion of LJB2197-1qcz_F with another copy which was not homozygous with the exception of the region around j-t-StCAT_p2_p-LuPXR, which seems to be a double copy event homozygous for each copy. For the T2 events selected, combined DHA and EPA levels were from nine to thirteen percent of the total fatty acids present in the seed. Whereas the selected T3 events had combined DHA and EPA levels varying from eleven to twenty three percent, with LALWPA having a DHA level of five percent and an EPA level of eighteen percent with respect to total fatty acid content in the seed, see Table 50. The selected events exhibited no morphological or anatomical defects relative to one another or to wild type.

Table 48: Copy number measurement of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of T2 plants that where measured per event. As the T2 plants underwent two cylces of selecting homozygous plants, all plants of all events are homozygous for all T-DNA insertions. A copy number of ~2 therefore was indicative of one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth. Odd results of 3 and 5 indicate that at least some of the selected T2 plants carry a heterozygous locus.

Event	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-i-Atss18_c-d6Elo(Pp_GA2) near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LLM337-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-t-PvARC-p3 located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border.								
	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-t-CaMV_p-LuCnl-2	c-d6Elo(Pp_GA)	j-i-Atss18_c-d6Elo(Pp_GA2)	j-t-PvARC-p3	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	j-i-Atss15_c-o3Des(Pi_GA2)	c-o3Des(Pir_GA)	j-p-VfSBPperm3_c-o3Des(Pir_GA)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
LANBCH (n=30)	4.0	3.7	4.1	4.0	4.4	4.0	3.8	2.9	3.9				3.8	3.8	3.8
LANPMZ (n=74)	2.0	2.0	2.0	2.0	1.6	2.0	2.0	1.8	2.1				2.0	2.0	2.1
LAOIKC (n=29)	2.1	4.0	3.9	4.2	4.3	4.1	4.3	2.3	2.0				2.1	2.3	2.2
LALHBO (n=29)	4.1	3.9	4.1	4.0	3.9	3.9	3.8	3.9	3.5				3.8	2.1	2.0
LALRCH (n=30)	4.1	3.8	4.0	3.9	3.4	4.1	4.0	3.9	4.1				3.6	3.8	4.0
LALWPA (n=29)	4.0	3.9	4.1	6.0	5.7	4.1	3.9	2.3	3.6				3.5	3.4	3.6
LALXOL (n=15)	2.1	2.1	2.1	4.1	2.7	2.0	2.1	0.9	1.2				1.2	1.1	1.2
LALXVM (n=30)	3.8	3.6	3.9	3.5	1.8	2.0	1.9	2.5	2.5				2.4	2.2	2.3
LALZGS (n=24)	1.9	4.0	3.8	4.0	1.8	2.0	2.0	2.1	2.0				2.0	2.1	2.2
LAMADR (n=44)	4.0	3.9	3.8	4.0	4.6	4.0	3.9	2.5	3.4				3.1	3.0	3.1
LAMQJH (n=30)	4.0	4.0	4.0	3.9	2.9	4.1	4.1	4.5	4.1				4.0	3.9	4.2
LAMQUI (n=36)	2.2	2.1	4.0	3.7	3.5	3.6	3.8	1.5	1.3				2.9	5.2	5.5
LAMRUR (n=30)	3.6	3.7	3.4	3.7	4.1	3.6	3.8	3.7	3.6				3.8	4.3	3.9
LANPSF (n=30)	4.0	4.0	3.8	3.9	4.1	3.9	4.1	1.5	3.5				3.4	4.3	3.9

Table 49: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc The events are indicated in the first column, along with the number of T3 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANBCH (n=30)	4.5 ± 0.6	0.2 ± 0	0.1 ± 0	4 ± 0.2	22.2 ± 1.1	31.1 ± 0.7	1 ± 0.1	4 ± 0.2	1.8 ± 0.2	0.2 ± 0	0.8 ± 0	0.6 ± 0	0.5 ± 0.1	0.1 ± 0	2.6 ± 0.3	1.8 ± 0.1	3.3 ± 0.1	11.4 ± 0.5	0.3 ± 0	0 ± 0	1.7 ± 0.1	4.4 ± 0.2	0 ± 0	2.3 ± 0.2	0.6 ± 0.1	0.4 ± 0.1
LANPMZ (n=74)	5 ± 0.4	0.2 ± 0	0 ± 0	3.6 ± 0.4	26.3 ± 2.1	35.2 ± 1.6	0.4 ± 0.1	4.6 ± 0.6	0.7 ± 0.2	0.1 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	1.1 ± 0.4	0.3 ± 0.2	2.4 ± 0.3	1.5 ± 0.2	3.1 ± 0.4	7.2 ± 0.8	0.3 ± 0.1	0 ± 0	1 ± 0.1	2.9 ± 0.5	0 ± 0	1.5 ± 0.3	0.4 ± 0.1	0.5 ± 0.1
LAOIKC (n=29)	5.1 ± 0.6	0.2 ± 0	0.1 ± 0	3.6 ± 0.3	22.1 ± 1.7	30.8 ± 1	0.9 ± 0.1	4 ± 0.3	1.8 ± 0.2	0.2 ± 0	0.8 ± 0.1	0.6 ± 0	0.5 ± 0.1	0.1 ± 0	3.1 ± 0.8	1.6 ± 0.3	5.9 ± 0.5	10.3 ± 0.8	0.3 ± 0	0 ± 0	1.3 ± 0.1	4 ± 0.3	0 ± 0	1.8 ± 0.2	0.4 ± 0.1	0.3 ± 0
LALHBO (n=29)	4.4 ± 0.3	0.2 ± 0.1	0 ± 0	3.9 ± 0.4	19.6 ± 2.3	28.8 ± 1.5	0.6 ± 0.1	4.9 ± 0.3	1.3 ± 0.3	0.2 ± 0.1	0.9 ± 0.1	0.7 ± 0	0.9 ± 0.3	0.3 ± 0.1	2.4 ± 0.3	2 ± 0.2	4.3 ± 0.3	13.4 ± 1.9	0.3 ± 0	0 ± 0	1.3 ± 0.2	5.7 ± 0.8	0 ± 0	2.7 ± 0.4	0.4 ± 0.1	0.6 ± 0.1
LALRCH (n=30)	4.6 ± 0.2	0.2 ± 0	0.1 ± 0	3.7 ± 0.3	22.3 ± 1.2	30.1 ± 1	0.9 ± 0.1	4.2 ± 0.2	1.6 ± 0.2	0.2 ± 0	0.8 ± 0	0.7 ± 0	0.7 ± 0.2	0.2 ± 0.1	2.7 ± 0.3	1.8 ± 0.2	4 ± 0.4	11.2 ± 0.8	0.3 ± 0	0 ± 0	1.8 ± 0.1	4.5 ± 0.4	0 ± 0	2.3 ± 0.4	0.6 ± 0.1	0.6 ± 0.2
LALWPA (n=29)	4.4 ± 0.2	0.2 ± 0.1	0 ± 0	3.3 ± 0.2	17.3 ± 1.6	25.6 ± 1.4	1 ± 0.1	4.4 ± 0.4	2.3 ± 0.3	0.4 ± 0.1	0.8 ± 0	0.7 ± 0	0.5 ± 0.2	0.2 ± 0	2 ± 0.2	1.6 ± 0.1	5.7 ± 0.7	14.8 ± 1.5	0.4 ± 0	0 ± 0	2.1 ± 0.2	7.3 ± 0.8	0 ± 0	4 ± 0.7	0.5 ± 0.1	0.3 ± 0.1
LALXOL (n=15)	4.4 ± 0.3	0.2 ± 0	0 ± 0	4.4 ± 0.6	21.4 ± 1.1	28.4 ± 1.2	0.4 ± 0.1	3.5 ± 0.3	0.8 ± 0.2	0.1 ± 0	0.9 ± 0.1	0.9 ± 0.1	2.5 ± 0.5	0.5 ± 0.2	2.2 ± 0.3	1.3 ± 0.3	8.7 ± 2.1	11.6 ± 1.3	0.3 ± 0	0 ± 0	0.8 ± 0.2	3.5 ± 0.8	0 ± 0	1.8 ± 0.4	0.1 ± 0.1	1 ± 0.2
LALXVM (n=30)	4.5 ± 1	0.2 ± 0	0 ± 0	3.8 ± 0.4	21.3 ± 1.6	28.8 ± 1.7	0.7 ± 0.2	4.5 ± 0.6	1.2 ± 0.6	0.2 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	1.5 ± 0.8	0.5 ± 0.3	2.7 ± 0.3	1.9 ± 0.3	4.7 ± 0.9	11.7 ± 1.3	0.3 ± 0	0 ± 0	1.4 ± 0.4	5.1 ± 0.8	0 ± 0	2.3 ± 0.3	0.4 ± 0.2	0.8 ± 0.4
LALZGS (n=24)	4.5 ± 0.7	0.3 ± 0	0 ± 0	3.4 ± 0.5	21.8 ± 1.8	29.4 ± 1.4	0.6 ± 0.1	4.2 ± 0.5	1.2 ± 0.3	0.2 ± 0	0.8 ± 0.1	0.7 ± 0.1	1.3 ± 0.3	0.3 ± 0.1	2.6 ± 0.3	1.8 ± 0.3	5.6 ± 0.6	12.1 ± 1.2	0.3 ± 0	0 ± 0	1.2 ± 0.1	4.7 ± 0.6	0 ± 0	2.1 ± 0.4	0.2 ± 0.2	0.8 ± 0.2
LAMADR (n=44)	3.7 ± 1.6	0.2 ± 0	0.1 ± 0	4 ± 0.5	22.3 ± 2.8	32.5 ± 1.5	0.8 ± 0.2	4.3 ± 0.6	1.9 ± 0.4	0.3 ± 0.1	0.9 ± 0.1	0.7 ± 0	0.5 ± 0.2	0.1 ± 0	2.2 ± 0.4	1.4 ± 0.2	4.4 ± 2	10.8 ± 1.6	0.3 ± 0	0 ± 0	1.6 ± 0.2	4.1 ± 0.5	0 ± 0	2.1 ± 0.3	0.5 ± 0.2	0.3 ± 0.1
LAMQJH (n=30)	4.9 ± 0.3	0.3 ± 0	0.1 ± 0.1	3.8 ± 0.3	21.9 ± 1.7	30.9 ± 1.1	1 ± 0.2	4.3 ± 0.3	2.2 ± 0.2	0.3 ± 0.1	0.8 ± 0	0.6 ± 0	0.2 ± 0.1	0 ± 0	3 ± 0.5	1.7 ± 0.2	3.4 ± 0.4	10.7 ± 1	0.3 ± 0.1	0 ± 0	1.8 ± 0.2	4.4 ± 0.6	0 ± 0	2.3 ± 0.5	0.7 ± 0.1	0.2 ± 0
LAMQUI (n=36)	3.2 ± 2	0.2 ± 0.1	0.1 ± 0	3.1 ± 0.8	25.1 ± 2.7	26 ± 1.4	1.1 ± 0.3	4.5 ± 0.9	1.5 ± 0.4	0.2 ± 0.1	0.7 ± 0.1	0.8 ± 0.1	1.1 ± 0.7	0.3 ± 0.2	2.2 ± 0.4	1.3 ± 0.3	4.7 ± 1.7	11.6 ± 2.2	0.2 ± 0	0 ± 0	2.4 ± 0.4	6.1 ± 0.9	0 ± 0	2.3 ± 0.6	0.6 ± 0.1	0.7 ± 0.3
LAMRUR (n=30)	4.9 ± 0.3	0.2 ± 0	0.2 ± 0.1	3.9 ± 0.3	23.4 ± 1.7	32 ± 1.1	1.1 ± 0.2	4 ± 0.5	2.3 ± 0.3	0.3 ± 0	0.8 ± 0.1	0.7 ± 0	0.2 ± 0.1	0 ± 0	2.9 ± 0.6	1.5 ± 0.2	4 ± 0.4	9.4 ± 0.9	0.2 ± 0.1	0 ± 0	1.6 ± 0.2	3.7 ± 0.3	0 ± 0	1.9 ± 0.3	0.6 ± 0.1	0.2 ± 0.1
LANPSF (n=30)	4.7 ± 0.2	0.3 ± 0	0.1 ± 0	3.9 ± 0.2	23.2 ± 1.3	30.9 ± 0.9	0.8 ± 0.1	4.5 ± 0.5	1.7 ± 0.3	0.3 ± 0	0.8 ± 0.1	0.7 ± 0	0.5 ± 0.1	0.1 ± 0	2.2 ± 0.2	1.5 ± 0.1	3.7 ± 0.7	9.9 ± 0.8	0.3 ± 0	0 ± 0	2.1 ± 0.2	4.4 ± 0.4	0 ± 0	2.3 ± 0.2	0.7 ± 0.2	0.3 ± 0.1
WT Kumily (n=46)	5 ± 0.1	0.4 ± 0	0.2 ± 0	2.6 ± 0.1	66.3 ± 1.7	16.8 ± 1.3	0 ± 0	6.1 ± 0.4	0 ± 0	0 ± 0	0.9 ± 0	1.2 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.5 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 50: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANBCH (n=1)	4.6	0.2	0.1	3.9	21.3	30.3	1.1	4.0	2.0	0.3	0.8	0.6	0.4	0.1	2.5	1.8	3.3	12.4	0.3	0.0	1.8	4.8	0.0	2.5	0.7	0.3
LANPMZ (n=1)	4.6	0.3	0.1	4.0	22.6	32.2	0.3	5.2	0.7	0.1	0.9	0.8	1.4	0.5	2.6	2.1	3.1	9.7	0.3	0.0	1.1	4.2	0.0	2.3	0.5	0.5
LAOIKC (n=1)	7.9	0.5	0.1	3.2	19.0	28.4	0.8	3.4	1.9	0.2	0.7	0.5	0.5	0.1	3.0	1.6	6.5	12.2	0.3	0.0	1.5	4.6	0.0	2.2	0.3	0.4
LALHBO (n=1)	4.1	0.1	0.0	3.6	16.4	26.5	0.6	4.8	1.5	0.3	0.9	0.7	1.1	0.4	2.7	2.3	4.3	16.6	0.4	0.0	1.4	7.0	0.0	3.5	0.5	0.6
LALRCH (n=1)	4.1	0.2	0.1	3.6	20.5	28.5	0.8	4.3	1.3	0.2	0.7	0.7	1.2	0.3	2.7	2.0	4.6	12.3	0.3	0.0	1.8	5.0	0.0	3.3	0.6	1.0
LALWPA (n=1)	4.7	0.2	0.0	3.0	14.6	20.2	1.1	4.7	2.8	0.7	0.8	0.7	0.7	0.2	1.6	1.6	5.4	18.1	0.4	0.0	2.0	10.0	0.0	5.7	0.5	0.4
LALXOL (n=1)	4.6	0.2	0.0	4.9	21.0	26.0	0.5	4.2	0.7	0.2	1.0	0.9	2.3	0.9	2.1	1.9	3.4	14.0	0.4	0.0	1.1	5.4	0.0	2.7	0.4	1.1
LALXVM (n=1)	4.7	0.3	0.0	3.7	18.3	26.9	0.5	4.5	0.8	0.2	0.8	0.9	2.4	0.8	2.7	2.2	4.7	14.3	0.3	0.0	1.1	5.6	0.0	2.8	0.4	1.1
LALZGS (n=1)	4.6	0.3	0.0	2.5	19.0	28.4	0.6	3.7	1.5	0.2	0.6	0.7	1.2	0.3	2.7	1.9	7.0	14.1	0.2	0.0	1.4	5.5	0.0	2.9	0.0	0.7
LAMADR (n=1)	4.2	0.2	0.1	3.6	17.2	29.3	0.9	3.4	3.1	0.4	0.7	0.7	0.5	0.1	2.6	1.5	5.8	14.7	0.3	0.0	2.1	5.1	0.0	2.7	0.5	0.3
LAMQJH (n=1)	4.8	0.3	0.1	3.0	17.7	28.1	0.7	4.6	2.3	0.4	0.7	0.6	0.4	0.1	2.2	1.5	4.7	14.4	0.4	0.0	2.2	6.8	0.0	3.5	0.5	0.2
LAMQUI (n=1)	0.2	0.1	0.1	3.8	24.4	25.8	1.2	2.4	1.9	0.4	0.7	0.8	1.1	0.3	2.2	1.6	4.0	14.9	0.2	0.0	2.2	7.3	0.0	3.1	0.6	0.8
LAMRUR (n=1)	4.9	0.2	0.3	4.2	20.3	32.0	1.1	3.2	2.7	0.3	0.8	0.6	0.0	0.0	3.0	1.7	4.0	11.3	0.3	0.0	1.8	3.8	0.0	2.7	0.6	0.3
LANPSF (n=1)	4.7	0.3	0.0	3.9	20.8	30.7	0.8	4.1	2.0	0.3	0.8	0.6	0.5	0.1	2.4	1.4	4.5	11.4	0.3	0.0	2.1	4.7	0.0	2.6	0.6	0.4
LANBCH (n=1)	4.6	0.2	0.1	3.9	21.3	30.3	1.1	4.0	2.0	0.3	0.8	0.6	0.4	0.1	2.5	1.8	3.3	12.4	0.3	0.0	1.8	4.8	0.0	2.5	0.7	0.3

Table 51: Phenotypic rating of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of T2 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), NoI: number of lobes(#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
LALHCY (n=1)	59.1 ± 3.3	9 ± 0	8.9 ± 0.4	9 ± 0	7 ± 0.9	3 ± 0	3 ± 0	5 ± 0	7.5 ± 1.4	4 ± 0.2	129.2 ± 3.5				
LANBCH (n=30)	51.9 ± 3.1	9 ± 0.2	8.5 ± 0.7	9 ± 0.2	8.1 ± 0.7	3 ± 0	3 ± 0	5 ± 0	8 ± 0.7	5 ± 0.8	127.7 ± 6.6			35.2 ± 2.8	30 ± 2
LANPMZ (n=74)	57.3 ± 1.6	9 ± 0	8.9 ± 0.4	9 ± 0	7.3 ± 0.7	3 ± 0	3 ± 0	5 ± 0	7.9 ± 1.1	4 ± 0	125.3 ± 5				
LAOIKC (n=29)	65.2 ± 2.1	9 ± 0	7.1 ± 1.7	7.4 ± 1.1	6.2 ± 2.9	3 ± 0	3 ± 0	5 ± 0	7.7 ± 2	4.1 ± 0.4	118.8 ± 5.8	4.9 ± 0.5	5.3 ± 2.3		
LALHBO (n=29)	61.3 ± 1.9	9 ± 0	7.9 ± 1.3	8.8 ± 0.4	7.3 ± 0.5	3 ± 0	3 ± 0	5.1 ± 0.4	8 ± 0.9	3.9 ± 0.4	128.3 ± 3.3				
LALRCH (n=30)	61.3 ± 1.8	9 ± 0	8.2 ± 1.4	7.8 ± 1	7.7 ± 1.9	3 ± 0	3 ± 0	5 ± 0	8.2 ± 1.3	3.8 ± 0.6	125 ± 3	5.2 ± 0.4	3.7 ± 1		
LALWPA (n=29)	60.4 ± 3.9	9 ± 0	9 ± 0	9 ± 0	7.6 ± 1.1	3 ± 0	3 ± 0	5 ± 0	7.6 ± 1.1	4.9 ± 0.8	127.3 ± 3.7				
LALXOL (n=15)	60.7 ± 4.6	9 ± 0	8.9 ± 0.7	8.2 ± 0.8	7.6 ± 0.9	3 ± 0	3 ± 0	5 ± 0	8.4 ± 0.9	4 ± 0.6	126 ± 4.6	5.4 ± 0.4	3.3 ± 1.3		
LALXVM (n=30)	56.7 ± 4	8.7 ± 1.3	9 ± 0	8.9 ± 0.4	7.3 ± 1.3	3 ± 0	3 ± 0	5 ± 0	7.3 ± 1.4	5.6 ± 1.3	121 ± 24.4				
LALZGS (n=24)	56.9 ± 6	9 ± 0	8.4 ± 1.3	9 ± 0	7.8 ± 1	3 ± 0	3 ± 0	5 ± 0	7.9 ± 0.9	5.1 ± 0.7	128.4 ± 5.5				
LAMADR (n=44)	59.9 ± 2.6	9 ± 0	8.7 ± 0.9	8.8 ± 0.5	7.5 ± 1.1	3 ± 0	3 ± 0	5 ± 0	8.2 ± 1.2	4 ± 0.2	126.5 ± 5.3				
LAMQJH (n=30)	60.3 ± 3.1	9 ± 0	8.5 ± 1.1	8.3 ± 0.6	8.1 ± 0.9	3 ± 0	3 ± 0	5 ± 0	8.6 ± 0.9	3.9 ± 0.3	124 ± 4.6	5.3 ± 0.4	4.7 ± 1.3		
LAMQUI (n=36)	59.6 ± 1.9	9 ± 0	9 ± 0	9 ± 0	8.3 ± 0.7	3 ± 0	3 ± 0	5 ± 0	8.3 ± 0.7	4.9 ± 0.5	129.3 ± 4.5				
LAMRUR (n=30)	55.1 ± 2.9	9 ± 0	9 ± 0	9 ± 0	7.3 ± 0.8	3 ± 0	3 ± 0	5 ± 0	7.4 ± 0.9	5.7 ± 0.8	126.8 ± 4.4				
LANPSF (n=30)	59.1 ± 3.3	9 ± 0	8.9 ± 0.4	9 ± 0	7 ± 0.9	3 ± 0	3 ± 0	5 ± 0	7.5 ± 1.4	4 ± 0.2	129.2 ± 3.5				
WT Kumily (n=46)														34.9 ± 1.1	32.2 ± 1

Fatty acid profiles of T2 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in field trials in USDA growth zones 3a-4b and 5a during summer.

Field data from the T3 seed indicate that field values are lower for EPA and DHA than what was observed in the greenhouse, with values ranging from six to thirteen percent of the total fatty acid content of the seed for EPA and DHA combined. These data show a difference in seed oil content observed in field studies compared to the greenhouse (e.g. comparing Table 54 with Table 51), see also Example 10. Results of this analysis are described in Example 20.

Table 52: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the field in field trials, corresponding to USDA zones 3a-4b and zone 5a , of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc The events are indicated in the first column, along with the number of T3 seed aliquots representing a plot were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANBCH (n=30)	5.1 ± 0.2	0.4 ± 0	0 ± 0	2.6 ± 0.1	26 ± 1.9	31.3 ± 1	0.7 ± 0.1	6.2 ± 0.4	1.2 ± 0.2	0.2 ± 0	0.7 ± 0	0.7 ± 0	0.7 ± 0.1	0.2 ± 0	1.9 ± 0.1	1.1 ± 0.1	3.4 ± 0.3	8.9 ± 0.8	0.3 ± 0	0 ± 0	1.4 ± 0.2	4.7 ± 0.4	0 ± 0	1.5 ± 0.2	0.4 ± 0.1	0.3 ± 0.1
LANPMZ (n=30)	4.9 ± 0.1	0.3 ± 0	0 ± 0	2.4 ± 0.1	30.7 ± 1.5	32.1 ± 0.8	0.3 ± 0	6.9 ± 0.3	0.5 ± 0.1	0.1 ± 0	0.7 ± 0	0.9 ± 0	1.4 ± 0.3	0.5 ± 0.1	2 ± 0.1	1.2 ± 0.1	2.9 ± 0.2	5.8 ± 0.5	0.3 ± 0	0 ± 0	0.8 ± 0.1	3.3 ± 0.2	0 ± 0	1 ± 0.1	0.4 ± 0.1	0.5 ± 0.1
LAOIKC (n=31)	5.2 ± 0.2	0.3 ± 0	0 ± 0	2.5 ± 0.1	26 ± 2.2	31.4 ± 1.1	0.8 ± 0.1	5.5 ± 0.3	1.4 ± 0.2	0.2 ± 0	0.7 ± 0	0.7 ± 0	0.6 ± 0.1	0.1 ± 0	2.4 ± 0.2	1.1 ± 0.1	5.7 ± 0.5	8 ± 0.6	0.2 ± 0	0 ± 0	1.1 ± 0.1	4.1 ± 0.3	0 ± 0	1.2 ± 0.2	0.1 ± 0.1	0.4 ± 0.1
LALHBO (n=29)	5.1 ± 0.2	0.2 ± 0.1	0 ± 0	2.5 ± 0.2	28 ± 6.4	30.3 ± 2	0.6 ± 0.2	6.7 ± 1.1	1.1 ± 0.4	0.2 ± 0.1	0.7 ± 0	0.8 ± 0.1	0.9 ± 0.2	0.3 ± 0.1	1.9 ± 0.4	1.1 ± 0.2	3.8 ± 1	8.5 ± 2.1	0.3 ± 0	0 ± 0	0.9 ± 0.3	4.2 ± 1	0 ± 0	1.2 ± 0.3	0.1 ± 0.1	0.4 ± 0.1
LALWPA (n=30)	5 ± 0.4	0.3 ± 0	0 ± 0	2.2 ± 0.2	21.3 ± 2.7	28.8 ± 1.8	0.8 ± 0.1	5.5 ± 0.5	1.6 ± 0.3	0.3 ± 0.1	0.7 ± 0	0.8 ± 0	1 ± 0.2	0.3 ± 0	2.3 ± 0.3	1.3 ± 0.1	6 ± 1.4	11.1 ± 1.3	0.3 ± 0	0 ± 0	1.5 ± 0.1	5.9 ± 0.7	0 ± 0	2 ± 0.3	0.3 ± 0.2	0.5 ± 0.1
LALXOL (n=29)	5.1 ± 0.2	0.3 ± 0.1	0 ± 0	2.6 ± 0.2	26.8 ± 1.9	29.7 ± 1.8	0.4 ± 0.1	6 ± 0.8	0.8 ± 0.2	0.2 ± 0.1	0.7 ± 0	1 ± 0.1	2.1 ± 0.7	0.5 ± 0.2	1.9 ± 0.2	1 ± 0.1	5.5 ± 1.6	8.5 ± 1	0.3 ± 0	0 ± 0	0.8 ± 0.1	3.8 ± 0.6	0 ± 0	1.1 ± 0.2	0 ± 0	0.8 ± 0.2
LALXVM (n=30)	5 ± 0.3	0.3 ± 0	0 ± 0	2.4 ± 0.1	29 ± 4	29.9 ± 1.3	0.5 ± 0.1	6.3 ± 0.9	0.8 ± 0.2	0.2 ± 0	0.7 ± 0	0.9 ± 0.1	1.3 ± 0.4	0.4 ± 0.1	2 ± 0.3	1.1 ± 0.1	4.4 ± 1.3	7.7 ± 1.8	0.3 ± 0	0 ± 0	0.8 ± 0.2	3.9 ± 0.9	0 ± 0	1.1 ± 0.3	0.2 ± 0.1	0.6 ± 0.2
LALZGS (n=29)	5.1 ± 0.2	0.2 ± 0.1	0 ± 0	2.6 ± 0.2	25.1 ± 1.4	30.6 ± 1.2	0.6 ± 0.1	5.9 ± 0.4	1 ± 0.1	0.2 ± 0	0.7 ± 0	0.8 ± 0	1 ± 0.2	0.3 ± 0.1	2.3 ± 0.1	1.2 ± 0.1	5.7 ± 0.5	8.8 ± 0.5	0.2 ± 0.1	0 ± 0	0.9 ± 0.1	4.5 ± 0.2	0 ± 0	1.2 ± 0.1	0 ± 0.1	0.7 ± 0.1
LAMADR (n=30)	5.1 ± 0.1	0.2 ± 0.1	0 ± 0	2.7 ± 0.2	25.9 ± 1	32 ± 1.2	0.7 ± 0.1	5.9 ± 0.4	1.3 ± 0.2	0.2 ± 0	0.7 ± 0	0.8 ± 0	0.7 ± 0.1	0.2 ± 0	2.1 ± 0.1	1 ± 0.1	4.7 ± 0.6	8 ± 0.7	0.3 ± 0	0 ± 0	1.3 ± 0.1	4.1 ± 0.3	0 ± 0	1.2 ± 0.1	0.2 ± 0.1	0.4 ± 0.1
LAMQUI (n=30)	4.7 ± 0.2	0.3 ± 0.1	0 ± 0	2.5 ± 0.2	28.8 ± 1.9	29 ± 1.6	0.8 ± 0.2	5.7 ± 0.5	1.2 ± 0.2	0.2 ± 0	0.6 ± 0	0.9 ± 0.1	1 ± 0.3	0.2 ± 0.1	1.7 ± 0.3	0.8 ± 0.1	4.6 ± 0.9	7.6 ± 1	0.2 ± 0	0 ± 0	2.1 ± 0.3	4.6 ± 0.7	0 ± 0	1.4 ± 0.2	0.5 ± 0.1	0.5 ± 0.1
LAMRUR (n=29)	5.1 ± 0.3	0.3 ± 0	0 ± 0	2.6 ± 0.1	28.5 ± 2.3	32 ± 1.9	0.8 ± 0.2	5.8 ± 0.8	1.3 ± 0.2	0.2 ± 0	0.7 ± 0.1	0.7 ± 0.1	0.4 ± 0.1	0 ± 0.1	2.1 ± 0.2	1 ± 0.1	3.8 ± 0.6	7.2 ± 0.7	0.2 ± 0.1	0 ± 0	1.3 ± 0.2	3.9 ± 0.4	0 ± 0	1.2 ± 0.2	0.3 ± 0.1	0.3 ± 0.1
LANPSF (n=28)	5.1 ± 0.2	0.3 ± 0.1	0 ± 0	2.6 ± 0.1	26.9 ± 1.8	31.4 ± 1.4	0.7 ± 0.2	6.1 ± 0.7	1.2 ± 0.3	0.2 ± 0	0.7 ± 0	0.8 ± 0	0.7 ± 0.2	0.2 ± 0.1	1.9 ± 0.2	1 ± 0.1	3.9 ± 0.9	7.6 ± 1.1	0.3 ± 0	0 ± 0	1.7 ± 0.2	4.2 ± 0.4	0 ± 0	1.4 ± 0.2	0.6 ± 0.2	0.4 ± 0.1
WT Kumily (n=60)	5 ± 0.3	0.4 ± 0	0.1 ± 0.1	2 ± 0.1	56.2 ± 4.2	23.3 ± 1.7	0 ± 0.1	9.5 ± 0.7	0.1 ± 0.2	0 ± 0	0.7 ± 0	1.1 ± 0.1	0.1 ± 0.1	0 ± 0	0.2 ± 0.3	0.1 ± 0.3	0.2 ± 0.5	0.4 ± 1.1	0.3 ± 0.1	0 ± 0	0 ± 0.2	0.2 ± 0.6	0 ± 0	0 ± 0.2		

Table 53: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in field trials, corresponding to USDA zones 3a-4b and zone 5a , of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first

column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANBCH (n=30)	5.3	0.4	0.1	2.5	25.5	29.5	0.7	6.1	1.3	0.3	0.6	0.7	0.8	0.2	1.9	1.1	3.7	10.1	0.2	0.0	1.4	5.2	0.0	1.6	0.2	0.4
LANPMZ (n=30)	5.1	0.3	0.0	2.3	27.1	31.5	0.2	6.9	0.4	0.1	0.7	0.9	2.1	0.8	2.4	1.5	3.0	6.8	0.3	0.0	0.9	4.1	0.0	1.4	0.5	0.6
LAOIKC (n=31)	5.3	0.3	0.0	2.6	23.3	32.0	0.8	5.3	1.5	0.2	0.7	0.7	0.5	0.1	2.5	1.2	6.1	8.9	0.2	0.0	1.2	4.5	0.0	1.4	0.1	0.4
LALHBO (n=29)	5.2	0.4	0.1	2.5	25.8	29.0	0.8	5.5	1.5	0.3	0.7	0.7	0.7	0.2	2.1	1.2	4.5	10.6	0.3	0.0	1.1	4.9	0.0	1.6	0.0	0.4
LALWPA (n=30)	5.9	0.4	0.0	2.0	15.4	27.9	0.8	5.2	2.5	0.5	0.7	0.7	0.9	0.2	2.7	1.4	7.1	13.2	0.4	0.0	1.8	6.9	0.0	2.7	0.0	0.4
LALXOL (n=29)	5.2	0.2	0.0	2.7	24.3	28.8	0.5	5.9	0.9	0.2	0.7	1.0	2.3	0.6	1.9	1.1	5.3	10.1	0.3	0.0	0.9	4.8	0.0	1.4	0.0	1.0
LALXVM (n=30)	4.9	0.3	0.1	2.4	26.7	28.2	0.5	5.3	0.8	0.2	0.7	0.9	1.6	0.5	2.1	1.2	5.3	10.2	0.3	0.0	0.8	4.5	0.0	1.4	0.1	0.9
LALZGS (n=29)	5.4	0.3	0.0	2.4	24.5	29.1	0.6	5.6	1.1	0.2	0.6	0.8	1.1	0.3	2.5	1.3	6.3	9.6	0.2	0.0	1.0	4.9	0.0	1.5	0.0	0.7
LAMADR (n=30)	5.2	0.3	0.0	2.6	25.6	30.1	0.7	5.5	1.4	0.3	0.7	0.8	0.8	0.1	2.1	1.0	5.4	9.1	0.3	0.0	1.3	4.5	0.0	1.5	0.0	0.4
LAMQUI (n=30)	4.4	0.4	0.0	2.3	26.7	26.2	0.9	5.3	1.2	0.2	0.6	0.9	1.3	0.3	2.0	1.0	5.0	9.8	0.2	0.0	2.4	6.0	0.0	1.7	0.6	0.7
LAMRUR (n=29)	6.3	0.3	0.0	2.8	34.5	23.3	0.5	4.5	1.1	0.2	0.5	0.5	0.4	0.1	2.3	1.2	3.5	9.6	0.2	0.0	1.1	5.1	0.0	1.7	0.0	0.3
LANPSF (n=28)	5.0	0.3	0.1	2.5	26.6	29.7	0.8	4.9	1.6	0.3	0.7	0.7	0.5	0.1	1.9	1.0	5.4	9.2	0.3	0.0	1.7	4.6	0.0	1.5	0.4	0.3

Table 54: Phenotypic rating of T2 plants cultivated in the field of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of field plots that where rated per event. Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	Oil	protein
LANBCH (n=30)	37.9 ± 1.2	27.9 ± 0.9
LANPMZ (n=30)	38.7 ± 1	27.8 ± 0.9
LAOIKC (n=31)	38.8 ± 1.1	28.1 ± 2.7
LALHBO (n=29)	37.9 ± 1.4	28.2 ± 0.7
LALWPA (n=30)	36.5 ± 1.4	28 ± 0.7
LALXOL (n=29)	38.4 ± 1.1	27.7 ± 0.6
LALXVM (n=30)	38.3 ± 1.1	27.7 ± 1
LALZGS (n=29)	39.5 ± 0.7	27.2 ± 0.6
LAMADR (n=30)	38.7 ± 0.9	27.6 ± 0.5
LAMQUI (n=30)	38.3 ± 0.9	28.7 ± 0.8
LAMRUR (n=29)	38.3 ± 1.1	27.8 ± 0.8
LANPSF (n=28)	38.4 ± 1.1	27.6 ± 0.8
WT Kumily (n=60)	38.7 ± 1.1	

Fatty acid profiles copy number measurements, and phenotypic observations of T3 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in greenhouses during winter

The data indicate that EPA and DHA are still being synthesized by the plant in the T4 seed/generation.

Table 55: Copy number measurement of T3 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of T3 plants that were measured per event. As the T3 plants underwent two cylces of selecting homozygous plants, all plants of all events are homozygous for all T-DNA insertions. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth.

Event	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-i-Atss18_c-d6Elo(Pp_GA2) near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LLM337-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target j-t-PvARC-p3 located near the left T-DNA border and target c-d4Des(Eg_GA) near the right T-DNA border.							
	c-AHAS	j-t-E9-p3-2	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-t-CaMV_p-LuCnl-2	c-d6Elo(Pp_GA)	j-i-Atss18_c-d6Elo(Pp_GA2)	j-t-PvARC-p3	c-d4Des(Tc_GA)	c-o3Des(Pi_GA2_SNP)	j-i-Atss15_c-o3Des(Pi_GA2)	c-o3Des(Pir_GA)	j-p-VfSBPperm3_c-o3Des(Pir_GA)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Eg_GA)
LANPMZ (n=74)	1.9					2	2.02		1.94				2.04		1.88

Table 56: Fatty acid profiles of T4 seeds harvested from T3 plants cultivated in greenhouses of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc The events are indicated in the first column, along with the number of T4 seed aliquots representing a plot were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANPMZ (n=30)	5.3 ± 0.3	0.2 ± 0	0 ± 0	3.6 ± 0.8	25.2 ± 5.3	38.1 ± 2.8	0.5 ± 0.1	4.1 ± 0.6	1.1 ± 0.3	0.1 ± 0.1	0.8 ± 0.2	0.7 ± 0	0.5 ± 0.1	0.1 ± 0.1	1.9 ± 0.2	0.9 ± 0.1	3.8 ± 0.6	6.9 ± 1.3	0.3 ± 0.1	0 ± 0	1.2 ± 0.4	2.6 ± 0.5	0 ± 0	1.5 ± 0.6	0.2 ± 0.1	0.3 ± 0.1

Table 57: Fatty acid profiles of one T4 seed batch per event harvested from T3 plants cultivated in greenhouses of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T4 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANPMZ (n=1)	4.9	0.2	0.0	4.0	19.5	38.5	0.5	3.6	1.6	0.2	1.0	0.7	0.4	0.0	1.6	0.8	4.8	9.2	0.4	0.0	1.7	3.8	0.0	2.5	0.0	0.2

Table 58: Phenotypic rating of T3 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of T3 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes(#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
LANPMZ (n=30)	42.4 ± 2	8.2 ± 0.8	8.7 ± 0.7	9 ± 0	8 ± 0.7	3 ± 0	5 ± 0	5 ± 0		5.2 ± 0.8	128.5 ± 8.5				

Fatty acid profiles and phenotypes of T3 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in field trials in USDA growth zones 8a-9a during winter

The data indicate that in the field the T4 seed are making EPA and DHA, but at lower levels than seen in the summer field trial (above, T2 plants cultivated in the field in summer)). The greenhouse data show higher oil content compared to the summer field trials (Comparison of Table 61 with Table 54). This data was analyzed in detail in Example 20.

Table 59: Fatty acid profiles of T4 seeds harvested from T3 plants cultivated in the field in USDA growth zones 8a-9a of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc The events are indicated in the first column, along with the number of T4 seed aliquots representing a plot were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANPMZ (n=56)	5.2 ± 0.5	0.3 ± 0.1	0.1 ± 0.2	2.6 ± 0.5	35.6 ± 2.7	30.4 ± 1.8	0.3 ± 0.1	7.1 ± 0.5	0.5 ± 0.3	0.1 ± 0.1	0.6 ± 0	0.9 ± 0.1	1.3 ± 0.3	0.4 ± 0.1	1.6 ± 0.2	1 ± 0.1	2.5 ± 0.3	4.5 ± 0.6	0.2 ± 0.1	0 ± 0	0.5 ± 0.3	2.6 ± 0.3	0 ± 0	0.7 ± 0.2	0.3 ± 0.1	0.5 ± 0.1
LAOIKC (n=16)	5.3 ± 0.2	0.3 ± 0	0 ± 0	2.5 ± 0.2	32.6 ± 2.2	29.9 ± 0.9	0.7 ± 0.1	5.9 ± 0.4	1 ± 0.2	0.2 ± 0	0.6 ± 0	0.7 ± 0	0.6 ± 0.1	0 ± 0	2.1 ± 0.1	1 ± 0.1	4.6 ± 0.4	6.2 ± 0.5	0.2 ± 0	0 ± 0	0.8 ± 0.1	3.3 ± 0.2	0 ± 0	0.9 ± 0.2	0 ± 0.1	0.4 ± 0.1
WT Kumily (n=83)	5.1 ± 0.5	0.4 ± 0.1	0.1 ± 0.1	2.1 ± 0.5	59.1 ± 1.8	21.3 ± 1.5	0 ± 0.1	9.5 ± 0.7	0 ± 0.1	0 ± 0	0.6 ± 0.1	1 ± 0.1	0.1 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0.1	0.1 ± 0.1	0.3 ± 0	0 ± 0	0 ± 0.1	0 ± 0.1	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 60: Fatty acid profiles of one T4 seed batch per event harvested from T3 plants cultivated in the field in USDA growth zones 8a-9a of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T4 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANPMZ (n=1)	4.9	0.3	0.0	2.3	31.2	32.0	0.2	7.6	0.4	0.1	0.6	0.9	1.6	0.6	1.6	1.1	2.8	5.7	0.2	0.0	0.8	3.3	0.0	1.1	0.4	0.5
LAOIKC (n=1)	5.4	0.3	0.0	2.4	29.6	30.3	0.7	5.5	1.4	0.2	0.5	0.7	0.5	0.0	2.2	1.1	5.4	7.3	0.2	0.0	1.0	3.6	0.0	1.3	0.0	0.3

Table 61: Phenotypic rating of T3 plants cultivated in the field in USDA growth zones 8a-9b of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of field plots that where rated per event. Oil: oil content in T4 seeds harvested from T3 plants (% of seed weight), Protein: Protein content in T4 seeds harvested from T3 plants (% of seed cake without oil)

Event	Oil	Protein
LANPMZ (n=56)	43.9 ± 7.8	23.2 ± 3.2
LAOIKC (n=16)	42.6 ± 4	23.1 ± 3
WT Kumily (n=83)	45.3 ± 3.9	

Fatty acid profiles and phenotypes of T4 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc cultivated in field trials in USDA growth zones 3a-4b and 5a during summer.

The data indicate that through the T5 generation the transformants are still producing EPA and DHA at a level consistent with the field trial of T2 plants in summer. An additional observation is that the oil levels are comparable between these two field trials.

Table 62: Fatty acid profiles of T5 seeds harvested from T4 plants cultivated in the fied in USDA growth zones 3a-4b and 5a of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc The events are indicated in the first column, along with the number of T4 seed aliquots representing a plot were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANPMZ (n=124)	4.5 ± 0.4	0.2 ± 0.1	0 ± 0	2.8 ± 0.4	34.7 ± 3.9	33 ± 4.8	0.1 ± 0.2	6.5 ± 0.8	0.6 ± 0.2	0.1 ± 0.1	0.7 ± 0.1	0.9 ± 0.1	0.7 ± 0.3	0.2 ± 0.1	1.7 ± 0.3	1.2 ± 1.3	2.8 ± 0.6	4.3 ± 1.9	0.3 ± 0.1	0 ± 0	0.7 ± 0.4	2.8 ± 0.6	0 ± 0.2	0.8 ± 0.3	0.1 ± 0.2	0.4 ± 0.2
WT Kumily (n=56)	4.5 ± 0.5	0.1 ± 0.1	0 ± 0	1.8 ± 1	60 ± 3.8	22.5 ± 3.6	0.6 ± 1.5	7.9 ± 2.2	0.1 ± 0.1	0 ± 0	0.8 ± 0.2	1 ± 0.4	0.1 ± 0	0 ± 0	0.2 ± 0.8	0 ± 0	0 ± 0	0 ± 0.1	0.2 ± 0.2	0 ± 0	0 ± 0.1	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 63: Fatty acid profiles of one T5 seed batch per event harvested from T4 plants cultivated in the field in USDA growth zones 3a-4b and 5a of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T5 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LANPMZ (n=1)	5.6	0.3	0.0	2.7	21.8	32.3	0.0	6.3	0.9	0.0	0.8	0.8	1.5	0.5	2.2	1.5	4.7	8.0	0.4	0.0	1.6	5.1	0.0	2.7	0.0	0.4

Table 64: Phenotypic rating of T4 plants cultivated in the field in USDA growth zones 3a-4b and 5a of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM337-1qcz rc. The events are indicated in the first column, along with the number of field plots that were rated per event. Oil: oil content in T5 seeds harvested from T4 plants (% of seed weight), Protein: Protein content in T5 seeds harvested from T4 plants (% of seed cake without oil)

Event	Oil	Protein
LANPMZ (n=124)	39.7 ± 2.7	25.8 ± 1.4
WT Kumily (n=56)	40.6 ± 2.3	26.4 ± 1.3

Example 12: Plants containing the T-DNAs of plasmid VC-LJB2197-1qcz and VC-LLM338-3qcz rc (combination C in example 5) for production of EPA and DHA in seeds

In this example, the genetic elements required for EPA and DHA synthesis were transferred into the plant genome on two different T-DNA. To this end, the two different plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc containing two different T-DNAs where cloned into Agrobacteria, and plant tissue was incubated according to example 5 at the same time with these two agrobacterial cultures that are identical apart from containing either VC-LJB2197-1qcz or VC-LLM338-3qcz rc. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of VC-LJB2197-1qcz. Only those plants where kept, that also contained the T-DNA of plasmid VC-LLM338-3qcz rc as confirmed by PCR, conducted as described in example 5. Only plants containing the T-DNA of plasmid VC-LJB2197-1qcz as well as the T-DNA of plasmid VC-LLM338-3qcz rc combine all the genetic elements required for EPA and DHA synthesis in seeds. The genetic elements of VC-LJB2197-1qcz and the function of each element are listed in Table 1. The genetic elements of VC-LLM338-3qcz rc and the function of each element was listed in Table 5. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LJB2197-1qcz and VC-LLM338-3qcz rc that are required for EPA and DHA synthesis are additionally listed in Table 65.

Table 65: Combined list of genes essential of EPA and DHA synthesis carried by the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc.

Genes encoding enzmyes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA)	VC-LJB2197-1qcz	1196	Delta-12 desaturase from *Phythophthora sojae*
c-d15Des(Ch_ERTp_GA)	VC-LLM338-3qcz rc	1238	Delta-15 desaturase from *Cochliobolus heterostrophus* C5
c-d6Des(Ot_febit)	VC-LJB2197-1qcz	1370	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Pp_GA2)	VC-LJB2197-1qcz	872	Delta-6 elongase from *Physcomitrella patens*
c-d6Elo(Tp_GA2)	VC-LJB2197-1qcz	818	Delta-6 elongase from *Thalassiosira pseudonana*
c-d5Des(Tc_GA2)	VC-LJB2197-1qcz	1319	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	VC-LLM338-3qcz rc	1085	Omega-3-desaturase from *Phythophthora infestans*
c-d5Elo(Ot_GA3)	VC-LLM338-3qcz rc	902	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Eg_GA)	VC-LLM338-3qcz rc	1625	Delta-4 desaturase from *Euglena gracilis*

Genes encoding enzmyes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length (bp)	Enzymatic function and source of encoded protein
c-d4Des(Tc_GA)	VC-LLM338-3qcz rc	1559	Delta-4 desaturase from *Thraustochytrium* sp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc cultivated in greenhouses during summer

The data in Table 67 and Table 68 indicate that for this construct the increase in EPA and DHA, when comparing single copy to double copy events, was more subtle, but double copy events still had an increase in EPA and DHA over single copy events. As observed in the other examples, there was no significant observed alteration of the phenotype of the plants bearing the T-DNA from both constructs.

Table 66: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49.

Category of T0 plants	Copy number assays targeting the T-DNA of VC-LJB2197-1qcz. Assays are listed according to the position of the assay target along the T-DNA, with assay of target c-AHAS was located near the left T-DNA border and assay of target c-d6Elo(Pp_GA) near the right T-DNA border.		Copy number assays targeting the T-DNA of VC-LLM338-3qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with assay of target c-d4Des(Eg_GA) was located near the left T-DNA border and assay of target c-d15Des(Ch_ERTp_GA) near the right T-DNA border.	
	c-AHAS	c-d6Elo(Pp_GA)	c-d4Des(Eg_GA)	c-d15Des(Ch_ERTp_GA)
sc (n=240)	1.0	1.0	1.2	1.2
dc (n=117)	1.6	1.7	1.8	2.0

Table 67: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 66. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=240)	5.8 ± 0.9	0.4 ± 0.3	0 ± 0	2.8 ± 0.9	34.2 ± 5.7	30.5 ± 3.3	0.2 ± 1.2	7.9 ± 1.6	0.7 ± 0.5	0.2 ± 0.2	0.9 ± 0.1	0.9 ± 0.1	1 ± 0.6	0.3 ± 0.3	1.6 ± 0.6	1 ± 0.5	3.5 ± 1.7	3 ± 1.1	0.4 ± 0.2	0 ± 0	0.5 ± 0.3	2.1 ± 0.8	0 ± 0	1.4 ± 0.6	0.4 ± 0.4	
dc (n=117)	5.8 ± 0.9	0.4 ± 0.2	0 ± 0	2.9 ± 0.4	31.7 ± 6.5	30.3 ± 3.3	0.2 ± 0.2	7.9 ± 1.9	1.3 ± 1.1	0.4 ± 0.5	0.9 ± 0.1	0.8 ± 0.1	0.7 ± 0.5	0.2 ± 0.2	1.8 ± 1	1.1 ± 0.6	4 ± 2.1	3.2 ± 1.3	0.4 ± 0.2	0 ± 0	0.8 ± 0.4	2.6 ± 0.9	0 ± 0.1	1.8 ± 0.6	0.6 ± 0.6	

Table 68: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 66. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	6.0	0.3	0.1	3.8	19.5	34.3	0.2	4.4	1.0	0.2	0.8	0.7	1.9	0.6	2.0	1.3	8.0	8.9	0.3	0.0	0.7	3.1	0.0	1.9	0.0	
dc (n=1)	5.8	0.4	0.0	3.2	19.5	29.5	0.1	8.5	1.6	0.7	0.9	0.7	1.7	0.7	1.6	1.2	6.5	7.2	0.4	0.0	0.9	4.9	0.0	3.9	0.3	

Table 69: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2197-1qcz and VC-LLM338-3qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 66. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
sc (n=240)	81.4 ± 12.3	1.3 ± 0.6	1.9 ± 1.1	2.2 ± 1.3	2.1 ± 1.3	3 ± 0.1	4.6 ± 0.7	5 ± 0.3	3.1 ± 1.4	3.6 ± 0.9	93.7 ± 15.3	2.3 ± 0.7	7.4 ± 1.7
dc (n=117)	78.6 ± 10.1	1.3 ± 0.5	1.9 ± 1	2.3 ± 1.4	2.4 ± 1.2	3 ± 0.1	4.6 ± 0.7	5 ± 0	3.1 ± 1.4	3.9 ± 4.6	93.1 ± 17.4	2.2 ± 0.6	7.5 ± 1.5

Example 13: Plants containing the T-DNAs of plasmid VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc (combination D in example 5) for production of EPA and DHA in seeds

In this example, the genetic elements required for EPA and DHA synthesis were transferred into the plant genome on two different T-DNAs. To this end, the two different plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc containing two different T-DNAs where cloned into agrobacteria, and plant tissue was incubated according to example 5 at the same time with these two agrobacterial cultures that are identical apart from containing either VC-LJB2755-2qcz rc or VC-LLM391-2qcz rc. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of VC-LJB2755-2qcz rc. Only those plants where kept, that also contained the T-DNA of plasmid VC-LLM391-2qcz rc as confirmed by PCR, conducted as described in example 5. Only plants containing the T-DNA of plasmid VC-LJB2755-2qcz rc as well as the T-DNA of plasmid VC-LLM391-2qcz rc combine all the genetic elements required for EPA and DHA synthesis in seeds. The genetic elements of VC-LJB2755-2qcz rc and the function of each element are listed in Table 2. The genetic elements of VC-LLM391-2qcz rc and the function of each element was listed in Table 6. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc that are required for EPA and DHA synthesis are additionally listed Table 70.

Table 70: Combined list of genes essential of EPA and DHA synthesis carried by the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc.

Genes encoding enzmyes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA)	VC-LJB2755-2qcz rc	1196	Delta-12 desaturase from *Phythophthora sojae*
c-d5Des(Tc_GA2)	VC-LJB2755-2qcz rc	1319	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-d6Des(Ot_febit)	VC-LJB2755-2qcz rc	1370	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Tp_GA2)	VC-LJB2755-2qcz rc	818	Delta-6 elongase from *Thalassiosira pseudonana*
c-o3Des(Pi_GA2)	VC-LJB2755-2qcz rc	1085	Omega-3-desaturase from *Phythophthora infestans*
c-o3Des(Pir_GA)	VC-LJB2755-2qcz rc	1091	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	VC-LLM391-2qcz rc	902	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Eg_GA)	VC-LLM391-2qcz rc	1625	Delta-4 desaturase from *Euglena gracilis*
c-d4Des(Tc_GA)_T564G	VC-LLM391-2qcz rc	1559	Delta-4 desaturase from *Thraustochytrium* spp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in greenhouses during summer

The data in Table 72, Table 73 and Table 74 show that this combination of constructs was able to insert the T-DNA into the genome, but EPA and DHA accumulation was again at a more subtle level than observed in previous examples. None the less the constructs successfully recapitulated the pathway to generate EPA and DHA and ARA with no impact on the aerial portion of the plant.

Table 71: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Considering that each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49

Event	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border.								Copy number assays targeting the T-DNA of VC-LLM391-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border.						
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Eg_GA)	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)
sc (n=184)	1.0							1.1	1.0	1.0		1.0		1.1	
dc (n=6)	1.0							2.1	1.1	1.5				2.2	

Table 72: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Considering that each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 71. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=184)	5.4 ± 0.5	0.3 ± 0.1	0.2 ± 0.1	3 ± 0.4	39.5 ± 5.1	31.2 ± 2.9	0.4 ± 0.1	6.1 ± 0.9	1.3 ± 0.5	0.3 ± 0.1	0.7 ± 0.1	0.8 ± 0.1	0.1 ± 0.1	0 ± 0	1.3 ± 0.4	0.8 ± 0.2	1.3 ± 0.6	4.2 ± 1.4	0.3 ± 0	0 ± 0	0.4 ± 0.2	1.5 ± 0.5	0 ± 0	0.6 ± 0.3	0.2 ± 0.1	
dc (n=6)	4.7 ± 0.8	0.3 ± 0.1	0.1 ± 0.1	2.9 ± 0.4	34.2 ± 5.2	30.6 ± 3.9	0.8 ± 0.6	5.8 ± 0.9	3.8 ± 3.4	0.9 ± 0.8	0.7 ± 0.1	0.8 ± 0	0.1 ± 0.1	0 ± 0	1.9 ± 1.3	1.2 ± 0.8	1.2 ± 1	5.9 ± 5.8	0.3 ± 0	0 ± 0	0.5 ± 0.2	1.9 ± 1.3	0 ± 0	0.6 ± 0.4	0.6 ± 0.6	

Table 73: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 71. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	3.8	0.1	0.1	2.8	41.9	22.2	1.0	5.5	1.9	0.4	0.8	1.0	0.1	0.0	2.1	1.6	1.4	8.4	0.4	0.0	0.5	2.6	0.0	1.0	0.3	
dc (n=1)	3.6	0.1	0.0	2.6	25.9	28.4	1.3	4.7	3.9	1.0	0.7	0.8	0.1	0.1	2.3	1.6	2.7	14.0	0.4	0.0	0.6	3.6	0.0	1.4	0.2	

Table 74: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 71. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
sc (n=184)	61.7 ± 7.8	1 ± 0	1.4 ± 1.2	1.6 ± 1.4	2.9 ± 2.5	3 ± 0	3 ± 0.1	5 ± 0	3.2 ± 2.5	3.7 ± 0.7	121.7 ± 9.4	4.9 ± 0.6	5.5 ± 2.1
dc (n=6)	63.7 ± 8	1 ± 0	1 ± 0	1.8 ± 1.3	2.8 ± 0.4	3 ± 0	3 ± 0	5 ± 0	2.8 ± 1	3.3 ± 1	123.3 ± 5.2	4.9 ± 1.2	5.5 ± 1.8

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in greenhouses during winter.

The data on Table 75, Table 76, Table 77, Table 78, Table 79, Table 80, Table 81 and Table 82 demonstrate that this pair of constructs was successful in recapitulating the pathway to generate VLC-PUFA (C20 and C22, including EPA, DHA and ARA). The copy number for each gene varied from homozygous single insertion of the T-DNA to insertions of parts of the T-DNA's and/or deletions of the T-DNA after insertion into the genome. The fatty acid profile indicated that some events (see Table 78, event LAPCSC) were able to accumulate up to 18 percent EPA and DHA combined). Table 75 indicates that LAPCSC was largely homozygous for a single insertion of each T-DNA with the exception of region of j-p-LuPXR_i-Atss15 on construct VC-LJB2755-2qcz, which contained at least four copies of the regions around that marker. The data presented on Table 81 indicate there was no obvious alteration of the phenotype of the plants bearing T-DNA corresponding to the constructs VC-LJB2755-2qcz and VC-LLM391-2qcz rc.

Table 75: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of T1 plants that were measured per event. The T1 plants underwent a selection from 250 segregating T1 seedlings using half-kernel analysis, where the correlation of VCL-PUFA levels with copy number was employed to select for homozygous plants, or on case of multilocus events to selecect for plants where one or more loci are homozygous. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth. Odd results of 3 and 5 indicate that at least some of the selected T1 plants carry a heterozygous locus.

Event	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity of all plants per event was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.								Copy number assays targeting the T-DNA of VC-LLM391-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.						
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Eg_GA)	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)
LAPCTC (n=11)	1.3 (T0: 1.1)			2.3		2.1		4.6 (T0: 3.6)	1.7 (T0: 1)	N/A (T0: 1.2)		1.7		1.7 (T0: 1.1)	
LAPCSC (n=11)	1.4 (T0: 1)			2.7		2.6		5.1 (T0: 4)	1.6 (T0: 1)	N/A (T0: 1)		1.7		1.6 (T0: 1.1)	
LAPYTJ (n=15)	1.7 (T0: 0.9)			3.2		3.3		3.2 (T0: 2.1)	1.7 (T0: 1.1)	N/A (T0: 1.1)		1.8		1.7 (T0: 1.1)	
LAQKQS (n=15)	1.5 (T0: 1.1)			1.7		1.4		2 (T0: 1.3)	1.4 (T0: 1)	N/A (T0: 1.1)		1.5		1.4 (T0: 1)	
LAPARV (n=15)	2 (T0: 1.1)			1.9		2.0		2 (T0: 1.1)	1.2 (T0: 1.1)	N/A (T0: 0.9)		1.2		1.2 (T0: 1.1)	
LAPCMY (n=15)	2 (T0: 1)			2.0		2.1		2.2 (T0: 1.1)	1.7 (T0: 1)	N/A (T0: 1.1)		1.7		1.9 (T0: 1.2)	
LAPBOW (n=15)	2 (T0: 1)			1.9		2.1		2 (T0: 1)	2 (T0: 1)	N/A (T0: 1.2)		1.9		2.1 (T0: 1.1)	
LAPAWA (n=15)	1.9 (T0: 1.1)			2.0		2.0		2.1 (T0: 1.1)	1.5 (T0: 1)	N/A (T0: 1)		1.5		1.5 (T0: 1.2)	
LAPBYW (n=13)	2 (T0: 1)			2.0		2.2		2.3 (T0: 1)	1.3 (T0: 1)	N/A (T0: 0.8)		1.3		1.5 (T0: 1.1)	
LAPQEP (n=15)	1.4 (T0: 0.9)			2.8		2.6		4 (T0: 3.1)	1.3 (T0: 0.9)	N/A (T0: 1.2)		1.4		1.4 (T0: 1.1)	
LAODDN (n=15)	2.1 (T0: 1.1)			2.0		2.1		2.1 (T0: 1.1)	2 (T0: 1)	N/A (T0: 1.1)		2.0		2.1 (T0: 1.1)	
LAPAUX (n=10)	1.5 (T0: 1)			1.6		1.7		1.7 (T0: 1)	1 (T0: 0.9)	N/A (T0: 0.8)		1.0		1.1 (T0: 0.6)	
LAPZOJ (n=10)	1.8 (T0: 1)			2.1		1.9		2 (T0: 1.1)	1.8 (T0: 1)	N/A (T0: 1.2)		1.9		1.9 (T0: 1)	

Table 76: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; sc: all T1 plants where the average of all copy number assays listed in this table was 1.51-2.49, dc: all T1 plants where the average of all copy number assays listed in this table was 3.51-4.49, tc: all T1 plants where the average of all copy number assays listed in this table was 5.51-6.49. The number of T1 plants fullfilling these criteria are displayed in parentheses.

Category of T1 plants	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity of all plants per event was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.						Copy number assays targeting the T-DNA of VC-LLM391-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.							
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Eg_GA)	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)
sc (n=140)	1.8			2.1		2.1		2.6	1.6			1.6		1.6

Table 77: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc The events are indicated in the first column, along with the number of T2 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPCTC (n=11)	5.1 ± 0.2	0.3 ± 0	0 ± 0	3 ± 0.3	28.2 ± 5.5	28.9 ± 1.6	1.3 ± 0.2	5 ± 0.2	3 ± 0.5	0.8 ± 0.2	0.9 ± 0.1	0.7 ± 0.1	0.2 ± 0	0.1 ± 0	2.2 ± 0.4	1.8 ± 0.5	1.2 ± 0.4	10.9 ± 2.1	0.4 ± 0	0 ± 0	0.6 ± 0.2	3.5 ± 1.1	0 ± 0	1.3 ± 0.4	0.4 ± 0.2	0.2 ± 0.1
LAPCSC (n=11)	5.1 ± 0.1	0.3 ± 0	0 ± 0	3.2 ± 0.4	27.9 ± 4.2	28.8 ± 2.3	1.3 ± 0.2	4.9 ± 0.4	3.2 ± 0.6	0.8 ± 0.2	0.9 ± 0.1	0.7 ± 0.1	0.2 ± 0.1	0.1 ± 0	2.1 ± 0.4	1.7 ± 0.5	1.3 ± 0.3	11.4 ± 2.4	0.4 ± 0.1	0 ± 0	0.6 ± 0.1	3.4 ± 1	0 ± 0	1.2 ± 0.3	0.3 ± 0.1	0.2 ± 0.1
LAPYTJ (n=15)	5.9 ± 0.3	0.3 ± 0.1	0 ± 0	3.3 ± 0.6	26.5 ± 1.9	34 ± 1.6	0.9 ± 0.2	4.9 ± 0.7	2.1 ± 0.3	0.4 ± 0.1	0.8 ± 0.1	0.6 ± 0	0 ± 0	0 ± 0	2.2 ± 0.3	1.3 ± 0.3	2.9 ± 0.5	8.4 ± 1.7	0.1 ± 0.1	0 ± 0	0.9 ± 0.3	2.8 ± 0.5	0 ± 0	1.2 ± 0.3	0.2 ± 0.2	0.1 ± 0.1
LAQKQS (n=15)	5.3 ± 0.3	0.3 ± 0.1	0 ± 0	3.2 ± 0.6	32.7 ± 8	29.7 ± 2.7	1.1 ± 0.3	5.3 ± 0.5	2.6 ± 0.6	0.6 ± 0.1	0.9 ± 0.2	0.7 ± 0.1	0.1 ± 0.1	0 ± 0	1.7 ± 0.6	1.3 ± 0.5	1.1 ± 0.2	8.8 ± 3.2	0.2 ± 0.2	0 ± 0	0.5 ± 0.3	2.4 ± 0.6	0 ± 0	1 ± 0.4	0.2 ± 0.2	0.1 ± 0.1
LAPARV (n=15)	5.3 ± 0.2	0.3 ± 0	0 ± 0	3.5 ± 0.3	26.5 ± 1.9	36 ± 1.2	0.7 ± 0.1	5.4 ± 0.3	1.9 ± 0.2	0.4 ± 0.1	0.9 ± 0.1	0.7 ± 0	0 ± 0	0 ± 0	1.9 ± 0.3	1.4 ± 0.2	1.7 ± 0.3	8.4 ± 1.6	0.4 ± 0	0 ± 0	0.6 ± 0.2	2.4 ± 0.5	0 ± 0	1.2 ± 0.3	0.3 ± 0.2	
LAPCMY (n=15)	6.2 ± 1.3	0.3 ± 0.1	0 ± 0	2.4 ± 1.4	34 ± 8.6	26.7 ± 14.5	0.5 ± 0.3	6.5 ± 1.4	1.9 ± 0.4	0.4 ± 0.1	1 ± 0.2	0.7 ± 0.1	0.1 ± 0.1	0 ± 0	2.5 ± 0.5	1.8 ± 0.4	1.6 ± 0.4	7.9 ± 2	0.4 ± 0.1	0 ± 0	0.6 ± 0.3	2.6 ± 0.8	0 ± 0	1.2 ± 0.4	0.3 ± 0.2	
LAPBOW (n=15)	5.1 ± 0.6	0.2 ± 0.1	0 ± 0	2.9 ± 0.2	27.3 ± 2.6	34.9 ± 0.9	0.7 ± 0	5.6 ± 0.6	1.9 ± 0.2	0.4 ± 0	0.8 ± 0.1	0.7 ± 0	0.1 ± 0	0 ± 0	2 ± 0.3	1.4 ± 0.2	1.6 ± 0.1	7.8 ± 1.1	0.3 ± 0	0 ± 0	0.9 ± 0.2	3.1 ± 0.7	0 ± 0	1.3 ± 0.4	0.6 ± 0.1	0.1 ± 0
LAPAWA (n=15)	5.2 ± 0.1	0.3 ± 0	0 ± 0	3.1 ± 0.2	28.3 ± 1.3	35.9 ± 1.1	0.7 ± 0.1	5.3 ± 0.3	1.7 ± 0.2	0.3 ± 0	0.8 ± 0.1	0.7 ± 0	0.1 ± 0.1	0 ± 0	2.1 ± 0.2	1.4 ± 0.2	1.6 ± 0.1	7.4 ± 0.7	0.3 ± 0	0 ± 0	0.7 ± 0.2	2.2 ± 0.5	0 ± 0	1 ± 0.3	0.5 ± 0.2	
LAPBYW (n=13)	5.6 ± 0.3	0.3 ± 0.1	0 ± 0	2.6 ± 1.2	28.4 ± 1.2	36 ± 1.2	0.7 ± 0.1	5.4 ± 0.3	1.7 ± 0.2	0.4 ± 0	0.8 ± 0.1	0.7 ± 0	0.1 ± 0.1	0.1 ± 0.1	1.9 ± 0.2	1.4 ± 0.2	1.6 ± 0.1	7.9 ± 0.8	0.4 ± 0.1	0 ± 0	0.5 ± 0.2	2 ± 0.4	0 ± 0	1 ± 0.2	0.3 ± 0.2	
LAPQEP (n=15)	5 ± 0.3	0.3 ± 0	0 ± 0	2.7 ± 0.3	38.1 ± 5.8	26.7 ± 4	1.1 ± 0.3	6.1 ± 0.9	1.2 ± 0.2	0.3 ± 0	0.8 ± 0.1	0.8 ± 0.1	0.2 ± 0.1	0.1 ± 0	1.6 ± 0.4	1.5 ± 0.4	0.7 ± 0.2	7.7 ± 1.6	0.4 ± 0	0 ± 0	0.4 ± 0.1	2.8 ± 0.7	0 ± 0	0.7 ± 0.2	0.3 ± 0.1	0.2 ± 0.1
LAODDN (n=15)	5.2 ± 0.6	0.2 ± 0.1	0 ± 0	3.1 ± 0.3	28 ± 2	35.8 ± 1.1	0.7 ± 0.1	5.9 ± 0.4	1.6 ± 0.2	0.4 ± 0	0.8 ± 0.1	0.7 ± 0	0 ± 0	0 ± 0	2 ± 0.2	1.4 ± 0.2	1.2 ± 0.1	7.1 ± 0.9	0.4 ± 0	0 ± 0	0.8 ± 0.1	2.8 ± 0.4	0 ± 0	1.1 ± 0.3	0.6 ± 0.1	0.1 ± 0
LAPAUX (n=10)	5.5 ± 0.5	0.3 ± 0	0 ± 0	2.8 ± 0.3	31.3 ± 7.3	34.9 ± 2.5	0.5 ± 0.1	6.1 ± 0.6	1.5 ± 0.5	0.4 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.1 ± 0	0 ± 0	1.7 ± 0.5	1.2 ± 0.4	1.7 ± 0.5	8.3 ± 3.4	0.4 ± 0	0 ± 0	0.2 ± 0.1	1.1 ± 0.4	0 ± 0	0.4 ± 0.2	0 ± 0.1	
LAPZOJ (n=10)	5.6 ± 0.6	0.3 ± 0	0 ± 0	3 ± 0.3	34.1 ± 6.8	33.5 ± 2.8	0.6 ± 0.2	6.5 ± 0.6	1.3 ± 0.3	0.3 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0 ± 0	0 ± 0	1.6 ± 0.4	1.1 ± 0.3	1 ± 0.2	5.5 ± 1.5	0.2 ± 0.1	0 ± 0	0.4 ± 0.2	2.2 ± 0.6	0 ± 0	0.8 ± 0.3	0.3 ± 0.2	0 ± 0

Table 78: Fatty acid profiles of one T2 seed batch per event harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column. Fatty acid profiles of T2 seed

batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPCTC (n=1)	5.1	0.3	0.0	2.7	25.2	29.7	1.3	4.8	2.6	0.5	0.8	0.6	0.3	0.1	2.4	1.9	1.9	14.1	0.3	0.0	0.4	3.3	0.0	1.0	0.2	0.3
LAPCSC (n=1)	5.0	0.3	0.0	3.4	20.8	25.8	1.7	5.2	3.5	1.0	0.8	0.6	0.3	0.1	2.5	2.7	1.0	16.1	0.3	0.0	0.6	5.3	0.0	1.9	0.4	0.3
LAPYTJ (n=1)	5.5	0.3	0.0	3.0	24.0	31.1	1.1	4.9	2.4	0.5	0.8	0.6	0.0	0.0	2.4	1.7	2.8	10.8	0.3	0.0	1.1	4.1	0.0	1.7	0.5	0.3
LAQKQS (n=1)	5.8	0.3	0.0	3.6	24.4	31.3	1.4	4.7	3.9	0.9	0.8	0.6	0.0	0.0	2.2	1.8	1.5	13.8	0.0	0.0	0.0	1.8	0.0	1.0	0.0	0.0
LAPARV (n=1)	5.3	0.2	0.0	3.2	24.3	34.2	0.6	5.6	2.0	0.5	0.8	0.6	0.1	0.0	2.0	1.5	2.3	11.9	0.3	0.0	0.6	2.4	0.0	1.1	0.3	
LAPCMY (n=1)	8.1	0.5	0.0	0.0	51.4	1.0	0.0	9.5	2.3	0.6	1.2	1.0	0.1	0.0	2.9	2.1	2.4	12.5	0.5	0.0	0.3	2.6	0.0	0.8	0.0	
LAPBOW (n=1)	3.8	0.1	0.0	2.3	21.5	33.7	0.7	6.7	2.3	0.6	0.7	0.7	0.1	0.1	2.2	1.8	2.0	10.8	0.4	0.0	1.5	5.2	0.0	2.1	0.7	0.1
LAPAWA (n=1)	5.3	0.3	0.0	3.4	26.2	36.5	0.7	4.8	1.8	0.4	0.9	0.7	0.0	0.0	2.7	1.9	1.7	8.7	0.4	0.0	0.5	1.7	0.0	0.9	0.3	
LAPBYW (n=1)	5.5	0.3	0.0	0.0	29.4	36.1	0.6	5.8	1.8	0.4	0.8	0.8	0.1	0.0	1.9	1.5	1.7	9.5	0.4	0.0	0.4	1.7	0.0	0.8	0.3	
LAPQEP (n=1)	4.9	0.4	0.0	2.3	36.6	23.9	1.5	5.7	1.3	0.4	0.7	0.8	0.3	0.1	1.9	1.6	1.0	10.9	0.4	0.0	0.3	3.7	0.0	0.7	0.3	0.3
LAODDN (n=1)	3.8	0.1	0.0	2.6	24.1	36.0	0.8	5.7	2.0	0.4	0.8	0.7	0.0	0.0	2.3	1.8	1.6	9.4	0.4	0.0	1.1	3.8	0.0	1.6	0.6	0.1
LAPAUX (n=1)	5.5	0.3	0.0	3.1	25.6	33.6	0.7	5.4	1.9	0.4	0.8	0.6	0.1	0.0	2.4	1.7	2.3	12.8	0.3	0.0	0.2	1.5	0.0	0.5	0.0	
LAPZOJ (n=1)	5.7	0.3	0.0	2.1	25.8	31.3	0.4	7.9	2.2	0.7	0.6	0.6	0.0	0.0	1.3	1.0	2.1	9.3	0.0	0.0	1.0	5.6	0.0	2.2	0.0	0.0

Table 79: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined in Table 76. The number of T1 plants fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=143)	5.4 ± 0.7	0.3 ± 0.1	0 ± 0	2.9 ± 0.7	29.6 ± 5.5	32.8 ± 6.2	0.8 ± 0.3	5.6 ± 0.8	1.9 ± 0.6	0.4 ± 0.2	0.8 ± 0.1	0.7 ± 0.1	0.1 ± 0.1	0 ± 0	2 ± 0.4	1.5 ± 0.3	1.5 ± 0.5	8.3 ± 2	0.3 ± 0.1	0 ± 0	0.6 ± 0.3	2.6 ± 0.7	0 ± 0	1.1 ± 0.4	0.4 ± 0.2	0.1 ± 0.1

Table 80: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as

defined in Table 76. For each category, the fatty acid profile of the plant having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	5.1	0.3	0.0	2.7	25.2	29.7	1.3	4.8	2.6	0.5	0.8	0.6	0.3	0.1	2.4	1.9	1.9	14.1	0.3	0.0	0.4	3.3	0.0	1.0	0.2	0.3

Table 81: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of T1 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes(#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
LAPCTC (n=11)	67.5 ± 1.5	1 ± 0	1 ± 0	1 ± 0	1.8 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	129.5 ± 3.5	3.6 ± 0.6	3.6 ± 0.9		
LAPCSC (n=11)	68.6 ± 3.3	1 ± 0	1 ± 0	1 ± 0	1.7 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.6 ± 0.8	126.4 ± 3.2	3.2 ± 0.3	3.9 ± 0.5		
LAPYTJ (n=15)	72.3 ± 7.1	1 ± 0	1.4 ± 1.1	1.1 ± 0.5	1.6 ± 0.8	3 ± 0	3 ± 0	5 ± 0	1.3 ± 0.7	4 ± 0	123 ± 4.9	3.6 ± 0.3	3.5 ± 0.8		
LAQKQS (n=15)	67.4 ± 4.4	1 ± 0	1.4 ± 0.8	1.1 ± 0.3	3.1 ± 1.6	3 ± 0	3 ± 0	5 ± 0	1.8 ± 1.5	4 ± 0	130.3 ± 4.8	3.8 ± 0.5	3.7 ± 1		
LAPARV (n=15)	68.1 ± 2.6	1 ± 0	1.2 ± 0.8	1 ± 0	2.3 ± 2.1	3 ± 0	3 ± 0	5 ± 0	1.3 ± 0.9	4 ± 0	128 ± 3.2	4 ± 0.6	3.9 ± 1.3		
LAPCMY (n=15)	68.7 ± 2.4	1 ± 0	1 ± 0	1 ± 0	1.7 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1 ± 0	3.9 ± 0.5	130.7 ± 1.8	3.6 ± 0.4	3.3 ± 0.7		
LAPBOW (n=15)	68.1 ± 0.9	1 ± 0	1 ± 0	1 ± 0	1.2 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	127.3 ± 3.2	4 ± 0.4	3.7 ± 1	35.3 ± 1.3	29.2 ± 0.3
LAPAWA (n=15)	66.5 ± 1.4	1 ± 0	1 ± 0	1 ± 0	1.2 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	128.7 ± 3.5	3.7 ± 0.4	2.6 ± 0.5		
LAPBYW (n=13)	65.7 ± 2.6	1 ± 0	1.2 ± 0.8	1.2 ± 0.6	1.7 ± 0.6	3 ± 0	3 ± 0	5 ± 0	1.2 ± 0.6	3.8 ± 0.6	128.1 ± 5.2	4 ± 0.5	3.9 ± 1.7		
LAPQEP (n=15)	66.9 ± 2.6	1 ± 0	1.2 ± 0.8	1 ± 0	1.7 ± 0.7	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	128 ± 4.6	3.2 ± 0.3	3.3 ± 0.6		
LAODDN (n=15)	69.3 ± 2	1 ± 0	1 ± 0	1 ± 0	1.2 ± 0.4	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	125.7 ± 3.2	3.9 ± 0.5	3.8 ± 1.2	36.6 ± 1.2	27.9 ± 0.4
LAPAUX (n=10)	70 ± 4.5	1 ± 0	1.3 ± 0.9	1 ± 0	3.1 ± 2.3	3 ± 0	3 ± 0	5 ± 0	2.4 ± 2.1	3.8 ± 0.6	130 ± 2.4	4.3 ± 0.5	4.5 ± 1.4		
LAPZOJ (n=10)	68 ± 6.7	1 ± 0	1.2 ± 0.6	1 ± 0	1.1 ± 0.3	3 ± 0	3 ± 0	5 ± 0	1 ± 0	4 ± 0	126.5 ± 3.4	3.8 ± 0.6	3.3 ± 0.9		

Table 82: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined in Table 76. The number of T1 plants fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal),

FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Category of T1 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
sc (n=143; n=30 for oil and protein)	67.9 ± 3	1 ± 0	1.1 ± 0.5	1 ± 0.2	1.7 ± 1.1	3 ± 0	3 ± 0	5 ± 0	1.1 ± 0.7	3.9 ± 0.3	127.9 ± 4	3.6 ± 0.4	3.5 ± 1.1	36 ± 1.4	28.5 ± 0.8

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in greenhouses during summer.

The data in Table 83 indicate the copy number of the selected events was a single insertion which was homozygous in the T3 seed. Fatty acid profile measurements, see Table 84 and Table 85, indicated the combination of T-DNAs from VC-LJB2755-2qcz and VC-LLM391-2qcz rc are capable of bringing in the VLC-PUFA pathway to successfully accumulate ARA, EPA and DHA. The data on Table 86 show that there was no significant impact on the aerial portion of the plant caused by VC-LJB2755-2qcz and VC-LLM391-2qcz rc.

Table 83: Copy number measurement of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of T2 plants that were measured per event. As the T2 plants underwent two cylces of selecting homozygous plants, all plants of all events are homozygous for all T-DNA insertions. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth.

Event	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border.							Copy number assays targeting the T-DNA of VC-LLM391-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border.						
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Eg_GA)	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)
LAPBOW (n=54)	1.9	2.0					2.0	2.4	2.0				2.0		2.0
LAODDN (n=63)	1.9	2.0					2.0	2.1	2.0				2.0		1.9

Table 84: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc The events are indicated in the first column, along with the number of T3 seed batches that where measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPBOW (n=54)	5.3 ± 0.3	0.3 ± 0.1	0.2 ± 0.1	3.4 ± 0.2	26.8 ± 1.9	35.6 ± 2.1	0.6 ± 0.1	6.1 ± 0.8	1.6 ± 0.2	0.4 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.1 ± 0.1	0 ± 0	1.8 ± 0.3	1.4 ± 0.3	1.4 ± 0.2	7.1 ± 0.8	0.3 ± 0.1	0 ± 0	1 ± 0.1	3.2 ± 0.5	0 ± 0	1.3 ± 0.3	0.6 ± 0.2	0.1 ± 0.1
LAODDN (n=63)	5.4 ± 0.4	0.3 ± 0.1	0.2 ± 0.1	3.5 ± 0.4	27.7 ± 2.4	35.4 ± 1.8	0.6 ± 0.1	6.5 ± 0.8	1.4 ± 0.2	0.4 ± 0	0.8 ± 0.1	0.7 ± 0	0.1 ± 0.1	0 ± 0	1.8 ± 0.2	1.4 ± 0.2	1 ± 0.2	6.8 ± 0.6	0.3 ± 0.1	0 ± 0	0.8 ± 0.1	3 ± 0.3	0 ± 0	1.1 ± 0.3	0.6 ± 0.1	0.1 ± 0.1
WT Kumily (n=46)	5 ± 0.1	0.4 ± 0	0.2 ± 0	2.6 ± 0.1	66.3 ± 1.7	16.8 ± 1.3	0 ± 0	6.1 ± 0.4	0 ± 0	0 ± 0	0.9 ± 0	1.2 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.5 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 85: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPBOW (n=1)	5.7	0.3	0.2	3.3	24.1	34.3	0.6	6.1	2.0	0.5	0.7	0.6	0.0	0.0	2.1	1.7	1.6	8.7	0.1	0.0	1.1	3.8	0.0	1.7	0.7	0.0
LAODDN (n=1)	5.3	0.3	0.2	3.1	25.1	34.7	0.7	6.0	1.8	0.5	0.7	0.7	0.0	0.0	2.2	2.0	1.1	8.7	0.3	0.0	0.8	3.6	0.0	1.5	0.7	0.1

Table 86: Phenotypic rating of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of T2 plants that where rated per event. Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	Oil	protein
LAPBOW (n=54)	34.8 ± 2.9	30.8 ± 2.3
LAODDN (n=63)	36.6 ± 3	28.6 ± 2.4
WT Kumily (n=46)	34.9 ± 1.1	32.2 ± 1

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in field trials in USDA growth zones 3a-4b and 5a during the summer

Field data for the T3 seed from the events carrying the T-DNA from VC-LJB2755-2qcz and VC-LLM391-2qcz rc, shown in Table 87 and Table 88, indicate that the plants are capable of making VLC-PUFAs in the field (ARA, EPA and DHA), though not at the level observed in the greenhouse. However, there was also a difference in seed oil content observed compared to the greenhouse (e.g. comparing Table 89 with Table 86). These observations are in agreement with previous examples where it was observed that increased oil contents in the field grown plants concomitant with a decrease in VLC-PUFAs, in particular EPA, DHA and ARA. A more detailed description of the observations regarding oil content and VLC-PUFAs is given in Example 20.

Table 87: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the field, corresponding to USDA growth zones 3a-4b and 5a, for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc The events are indicated in the first column, along with the number of T3 seed aliquots representing a plot where measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPBOW (n=31)	5.3 ± 0.2	0.4 ± 0.1	0 ± 0	2.4 ± 0.1	31.9 ± 1.6	33.3 ± 1	0.6 ± 0.1	7.7 ± 0.5	1.4 ± 0.2	0.4 ± 0.1	0.6 ± 0	0.7 ± 0	0.1 ± 0.1	0 ± 0	1.5 ± 0.1	0.9 ± 0.1	1.6 ± 0.2	5.5 ± 0.5	0.2 ± 0.1	0 ± 0	0.9 ± 0.1	3.1 ± 0.3	0 ± 0	0.8 ± 0.1	0.4 ± 0.1	0.1 ± 0.1
LAODDN (n=31)	5.1 ± 0.2	0.4 ± 0	0.1 ± 0	2.5 ± 0.2	32.1 ± 2.3	33.4 ± 1.4	0.6 ± 0.1	7.9 ± 0.5	1.3 ± 0.2	0.4 ± 0.1	0.6 ± 0	0.7 ± 0	0.2 ± 0.1	0.1 ± 0.1	1.3 ± 0.1	0.8 ± 0.1	1.4 ± 0.2	5.7 ± 0.7	0.3 ± 0	0 ± 0	0.8 ± 0.1	3.1 ± 0.4	0 ± 0	0.8 ± 0.1	0.4 ± 0.1	0.1 ± 0
WT Kumily (n=60)	5 ± 0.3	0.4 ± 0	0.1 ± 0.1	2 ± 0.1	56.2 ± 4.2	23.3 ± 1.7	0 ± 0.1	9.5 ± 0.7	0.1 ± 0.2	0 ± 0	0.7 ± 0	1.1 ± 0.1	0.1 ± 0.1	0 ± 0	0.2 ± 0.3	0.1 ± 0.3	0.2 ± 0.5	0.4 ± 1.1	0.3 ± 0.1	0 ± 0	0 ± 0.2	0.2 ± 0.6	0 ± 0	0 ± 0.2		

Table 88: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in USDA growth zones 3a-4b and 5a for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPBOW (n=1)	5.5	0.4	0.1	2.3	30.3	32.9	0.6	7.6	1.8	0.5	0.6	0.7	0.1	0.0	1.6	1.0	1.7	6.5	0.1	0.0	1.0	3.5	0.0	1.1	0.2	0.1
LAODDN (n=1)	5.4	0.4	0.0	2.6	30.1	33.3	0.7	6.9	1.5	0.4	0.6	0.6	0.1	0.0	1.5	0.9	1.8	6.8	0.2	0.0	1.0	3.5	0.0	0.9	0.4	0.1

Table 89: Phenotypic rating of T2 plants cultivated in USDA growth zones 3a-4b and 5a for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of field plots that where rated per event. Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	Oil	protein
LAPBOW (n=31)	38.7 ± 1.2	28 ± 1.1
LAODDN (n=31)	38.3 ± 1.4	27.9 ± 1.2
WT Kumily (n=60)	38.7 ± 1.1	

Fatty acid profiles, copy number measurements, and phenotypic observations of T3 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in greenhouses during winter.

T4 seed from T3 plants from the event LAODDN, which was homozygous for T-DNA from both VC-LJB2755-2qcz and VC-LLM391-2qcz rc (see Table 90) accumulated VLC-PUFAs (in particular ARA, EPA and DHA, see Table 91 and Table 92). The combination of EPA and DHA was up to approximately ten percent of the total fatty acid content in the seed for this event.

Table 90: Copy number measurement of T3 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of T3 plants that where measured per event. As the T3 plants underwent two cylces of selecting homozygous plants, all plants of all events are homozygous for all T-DNA insertions. A copy number of ~2 therefore was indicative for one homozygous locus, a copy number of ~4 indicative for two homozygous loci or indicative for one homozygous locus containing two copies of the target gene measured by the assay, and so forth.

Event	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border.								Copy number assays targeting the T-DNA of VC-LLM391-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border.							
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Eg_GA)	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)
LAODDN (n=30)	1.92		2.0					1.9	1.8			1.9	2.1		1.9

Table 91: Fatty acid profiles of T4 seeds harvested from T3 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc The events are indicated in the first column, along with the number of T4 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAODDN (n=30)	5.3 ± 0.5	0.3 ± 0	0 ± 0	3.3 ± 0.7	27.2 ± 2.5	37.7 ± 4.1	2.3 ± 5.1	5.1 ± 0.7	1.7 ± 0.3	0.4 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.1 ± 0.1	0 ± 0	1.2 ± 0.2	0.3 ± 0.5	1.3 ± 0.2	6.5 ± 0.8	0.2 ± 0.2	0 ± 0	1 ± 0.3	2.7 ± 0.4	0 ± 0	1.3 ± 0.4	0.4 ± 0.1	0 ± 0

Table 92: Fatty acid profiles of one T4 seed batch per event harvested from T3 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column. Fatty acid profiles of T4 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAODDN (n=1)	5.2	0.2	0.0	3.7	24.2	39.5	0.4	4.8	2.0	0.5	0.9	0.6	0.1	0.1	1.0	0.0	1.5	7.7	0.4	0.0	1.3	3.3	0.0	1.9	0.3	0.1

Table 93: Phenotypic rating of T3 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of T3 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (9=deformed, 1=normal), DL: deformed leaf (9=deformed, 1=normal), DP: deformed plant (9=deformed, 1=normal), DS: deformed silique (9=deformed, 1=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), NoI: number of lobes (#), PH: plant height (cm)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH
LAODDN (n=30)	43.5 ± 4.1	8.5 ± 0.5	7.8 ± 0.8	9 ± 0	7.9 ± 1	3 ± 0	4.6 ± 0.7	4.5 ± 0.7	8.8 ± 0.4	5 ± 0.8	115 ± 12.5

Fatty acid profiles, copy number measurements, and phenotypic observations of T3 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in field trials in USDA growth zones 8a-9a in the winter.

Field data for T4 seed of two events carrying homozygous T-DNA insertions from VC-LJB2755-2qcz and VC-LLM391-2qcz rc (see Table 83 and Table 90 and Table 84, Table 87, Table 91) indicate these events do accumulate EPA, DHA and ARA when grown in the greenhouse and field, though as consistently observed, the field grown material did not accumulate the VLC-PUFAs (ARA, EPA, DHA) to the extent observed in the greenhouse (see Table 94 and Table 95 in comparison with Table 91, Table 92, Table 87 and Table 88). As observed in in Example 11 part F, higher oil content was observed compared to the summer field trials (Comparison Table 96 with Table 89). This phenomenon is analyzed in detail in Example 20.

Table 94: Fatty acid profiles of T4 seeds harvested from T3 plants cultivated in the field corresponding to USDA growth zones 8a-9a for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc The events are indicated in the first column, along with the number of T4 seed aliquots representing a plot were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPBOW (n=16)	5.3 ± 0.2	0.4 ± 0	0 ± 0	2.4 ± 0.2	36.1 ± 3.1	31.3 ± 2	0.5 ± 0.1	7.9 ± 0.5	1.3 ± 0.3	0.4 ± 0.1	0.6 ± 0	0.7 ± 0	0.1 ± 0.1	0 ± 0	1.2 ± 0.1	0.8 ± 0.1	1.4 ± 0.2	4.5 ± 0.5	0.2 ± 0	0 ± 0	0.7 ± 0.2	2.7 ± 0.2	0 ± 0	0.7 ± 0.2	0.3 ± 0.2	0.1 ± 0.1
LAODDN (n=47)	5.5 ± 0.6	0.5 ± 0.2	0.2 ± 0.3	2.7 ± 0.5	36.8 ± 3.2	30.3 ± 2.2	0.6 ± 0.2	7.9 ± 0.5	1.3 ± 0.3	0.4 ± 0.1	0.6 ± 0.1	0.7 ± 0	0.1 ± 0.1	0 ± 0	1 ± 0.1	0.8 ± 0.1	1.2 ± 0.2	4.7 ± 0.7	0.2 ± 0	0 ± 0	0.4 ± 0.3	2.6 ± 0.3	0 ± 0	0.6 ± 0.2	0.2 ± 0.1	0.1 ± 0.1
WT Kumily (n=83)	5.1 ± 0.5	0.4 ± 0.1	0.1 ± 0.1	2.1 ± 0.5	59.1 ± 1.8	21.3 ± 1.5	0 ± 0.1	9.5 ± 0.7	0 ± 0.1	0 ± 0	0.6 ± 0.1	1 ± 0.1	0.1 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0.1	0.1 ± 0.1	0.3 ± 0	0 ± 0	0 ± 0.1	0 ± 0.1	0 ± 0	0 ± 0	5.1 ± 0.5	0.4 ± 0.1

Table 95: Fatty acid profiles of one T4 seed batch per event harvested from T3 plants cultivated in the field corresponding to USDA growth zones 8a-9a for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column. Fatty acid profiles of T4 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAPBOW (n=1)	5.3	0.4	0.0	2.3	31.5	34.0	0.5	7.3	1.8	0.6	0.6	0.7	0.1	0.0	1.2	0.8	1.8	5.5	0.2	0.0	1.0	3.1	0.0	1.1	0.2	0.0
LAODDN (n=1)	5.6	0.4	0.0	2.1	33.8	31.1	0.7	8.0	1.5	0.5	0.5	0.7	0.1	0.0	1.2	0.8	1.6	6.2	0.1	0.0	0.7	3.3	0.0	1.0	0.2	0.1

Table 96: Phenotypic rating of T3 plants cultivated in the field corresponding to USDA growth zones 8a-9a for trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of field plots that were rated per event. Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	Oil	protein
LAPBOW (n=16)	42.9 ± 4.2	23.3 ± 3.1
LAODDN (n=47)	43.5 ± 3.8	22.7 ± 2.7
WT Kumily (n=83)	45.3 ± 3.9	

Fatty acid profiles, copy number measurements, and phenotypic observations of T4 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc cultivated in field trials in USDA zones 3a-4b and 5a during the summer.

The data indicate that through the T5 generation the event LAODDN was still producing EPA and DHA at a level consistent with the field trial (described in part D). Also oil content was comparable between these two field trials.

Table 97: Fatty acid profiles of T5 seeds harvested from T4 plants cultivated in the field corresponding to USDA growth zones 3a-3b and 5a for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc The events are indicated in the first column, along with the number of T5 seed aliquots representing a plot where measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAODDN (n=142)	4.7 ± 0.4	0.2 ± 0.1	0 ± 0	2.8 ± 0.4	34.8 ± 3.5	33.8 ± 4.8	0.3 ± 0.3	7.7 ± 1	1.1 ± 0.4	0.2 ± 0.2	0.7 ± 0.1	0.8 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	1.2 ± 0.3	1.1 ± 1.2	1.4 ± 0.4	4.5 ± 1.9	0.3 ± 0.1	0 ± 0	0.5 ± 0.4	2.9 ± 0.5	0.1 ± 0.2	0.7 ± 0.2	0.1 ± 0.2	0.1 ± 0.1
WT Kumily (n=56)	4.5 ± 0.5	0.1 ± 0.1	0 ± 0	1.8 ± 1	60 ± 3.8	22.5 ± 3.6	0.6 ± 1.5	7.9 ± 2.2	0.1 ± 0.1	0 ± 0	0.8 ± 0.2	1 ± 0.4	0.1 ± 0	0 ± 0	0.2 ± 0.8	0 ± 0	0 ± 0	0 ± 0.1	0.2 ± 0.2	0 ± 0	0 ± 0.1	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 98: Fatty acid profiles of one T5 seed batch per event harvested from T4 plants cultivated in the field corresponding to USDA growth zones 3a-3b and 5a for field trials of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column. Fatty acid profiles of T5 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LAODDN (n=1)	4.5	0.2	0.0	2.6	30.3	30.8	0.4	5.8	0.6	0.1	0.6	0.9	0.3	0.4	2.4	1.3	3.7	8.1	0.3	0.0	0.0	4.2	1.2	1.2	0.0	0.0

Table 99: Phenotypic rating of T4 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LLM391-2qcz rc. The events are indicated in the first column, along with the number of field plots that were rated per event. Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	Oil	protein
LAODDN (n=47)	39.9 ± 4.4	25.4 ± 1.8
WT Kumily (n=56)	40.6 ± 2.3	26.4 ± 1.3

Example 14: Plants containing the T-DNAs of plasmid VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc (combination E in example 5) for production of EPA and DHA in seeds

In this example, the genetic elements required for EPA and DHA synthesis were transferred into the plant genome on two different T-DNAs. To this end, the two different plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc containing two different T-DNAs were cloned into Agrobacteria, and plant tissue was incubated according to example 5 at the same time with these two agrobacterial cultures that are identical apart from containing either VC-LJB2755-2qcz rc or VC-LTM217-1qcz rc rc. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of VC-LJB2755-2qcz rc. Only those plants were kept, that also contained the T-DNA of plasmid VC-LTM217-1qcz rc rc as confirmed by PCR, conducted as described in example 5. Only plants containing the T-DNA of plasmid VC-LJB2755-2qcz rc as well as the T-DNA of plasmid VC-LTM217-1qcz rc combined all the genetic elements required for EPA and DHA synthesis in seeds. The genetic elements of VC-LJB2755-2qcz rc and the function of each element are listed in Table 2. The genetic elements of VC-LTM217-1qcz rc and the function of each element were listed in Table 7. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LJB2755-2qcz rc and VC- LTM217-1qcz rc that were required for EPA and DHA synthesis are additionally listed Table 100.

Table 100: Combined list of genes essential of EPA and DHA synthesis carried by the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc.

Genes encoding enzmyes for EPA and DHA synthesis	Plasmid containing T-DNA with the gene	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA)	VC-LJB2755-2qcz rc	1196	Delta-12 desaturase from *Phythophthora sojae*
c-d6Des(Ot_febit)	VC-LJB2755-2qcz rc	1370	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Tp_GA2)	VC-LJB2755-2qcz rc	818	Delta-6 elongase from *Thalassiosira pseudonana*
c-d5Des(Tc_GA2)	VC-LJB2755-2qcz rc	1319	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	VC-LJB2755-2qcz rc	1085	Omega-3-desaturase from *Phythophthora infestans*
c-o3Des(Pir_GA)	VC-LJB2755-2qcz rc	1091	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	VC-LTM217-1qcz rc	902	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Pl_GA)2	VC-LTM217-1qcz rc	1338	Delta-4 desaturase from *Pavlova lutheri*
c-d4Des(Tc_GA)	VC-LTM217-1qcz rc	1560	Delta-4 desaturase from *Thraustochytrium* spp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc cultivated in greenhouses during winter.

Table 102 and Table 103 indicate the single copy events for insertions of VC-LJB2755-2qcz and VC-LTM217-1qcz rc did not accumulate as much EPA and DHA as the double copy events. Table 103 indicates that the combined EPA and DHA content, for the highest producers in T1 seed, was in the range of 15 percent of the total fatty acid content of the seed (5% of the total seed fatty acid content being DHA and 10% being EPA).

Table 101: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49,

Event	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border.								Copy number assays targeting the T-DNA of VC-LTM217-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border.						
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Pl_GA)2	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)
sc (n=139)	1.2	1.2					1.2	1.2	1.2		1.1	1.2			1.1
dc (n=77)	1.6	1.8			2.0		1.8	1.8	1.9		1.9	1.7			1.9

Table 102: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 101. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=139)	5.1 ± 0.5	0.3 ± 0.1	0 ± 0.1	3.7 ± 0.8	37.8 ± 7.2	32 ± 4.4	0.4 ± 0.3	4.6 ± 0.6	1.7 ± 1.2	0.3 ± 0.3	0.9 ± 0.1	0.8 ± 0.1	0 ± 0.1	0 ± 0	1.4 ± 0.6	0.8 ± 0.4	1.8 ± 0.7	4.8 ± 1.8	0.4 ± 0.1	0 ± 0.3	0.2 ± 0.2	0.8 ± 0.5	0.3 ± 0.4	1.4 ± 0.6	0.1 ± 0.2	0 ± 0.1
dc (n=77)	5 ± 0.4	0.3 ± 0.1	0 ± 0.1	3.7 ± 0.6	35.5 ± 7.4	32.8 ± 4.4	0.5 ± 0.2	4.7 ± 0.8	1.8 ± 0.7	0.3 ± 0.1	0.9 ± 0.1	0.8 ± 0.1	0 ± 0.1	0 ± 0	1.5 ± 0.8	0.9 ± 0.5	1.7 ± 0.6	5.5 ± 2.6	0.3 ± 0.1	0 ± 0	0.3 ± 0.2	1 ± 0.5	0.4 ± 0.4	1.7 ± 0.6	0.2 ± 0.3	0 ± 0.1

Table 103: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 101. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	5.0	0.4	0.0	2.9	32.0	26.7	1.3	3.3	3.4	0.6	0.9	0.8	0.1	0.0	1.6	1.0	2.7	10.3	0.4	0.0	1.2	0.0	0.0	5.2	0.2	0.1
dc (n=1)	5.1	0.2	0.1	5.1	23.3	31.7	0.7	3.8	2.9	0.6	1.0	0.8	0.2	0.1	1.7	1.3	2.2	12.5	0.4	0.0	0.5	1.9	0.7	3.0	0.2	0.1

Table 104: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined inTable 101. The number of T0 plants fullfilling these criteria are displayed in parentheses. TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Category of T0 plants	TKW	SC	Oil	Protein
sc (n=139)	4.3 ± 0.5	5 ± 1.8	33.3 ± 1.6	30.5 ± 0.6
dc (n=77)	4.1 ± 0.5	5.3 ± 2	33.5 ± 3	29.7 ± 1.1

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc cultivated in greenhouses during summer.

Measurements carried out on plants from selected T1 events indicated single copy homozygous insertions of the T-DNA corresponding to VC-LJB2755-2qcz and VC-LTM217-1qcz rc (see table 104, in particular the table legend) and the T2 accumulates EPA and DHA in similar levels as the T1. Measurements on T2 seed (see Table 106 and Table 107) showed that EPA and DHA accumulated up to 13% of the total fatty acid content of the seed (with ca. 3% of the seed total fatty acid content being DHA).

Table 105: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. Homozygous plants of the T1 generation of these two events have been selected using Half Kernel Analysis (Example 9). Based on the proven ability to discriminate homozygous and heterozygous seeds using half kernel analysis, it can be assumed all T1 plants in Table 106, Table 107, and Table 108 are homozygous, but no copy number analysis has been performed to confirm this.

Event	Copy number assays targeting the T-DNA of VC-LJB2755-2qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target j-p-LuPXR_i-Atss15 near the right T-DNA border.								Copy number assays targeting the T-DNA of VC-LTM217-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-d4Des(Eg_GA) located near the left T-DNA border and target j-i-Atss1_c-d5Elo(Ot_GA3) near the right T-DNA border.					
	c-AHAS	c-o3Des(Pi_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-i-Atss1_c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	j-p-LuPXR_i-Atss15	c-d4Des(Pl_GA)2	j-t-PvARC-p-LuCnl	j-i-Atss2_c-d4Des(Tc_GA3)	c-d4Des(Tc_GA)	j-p-PvARC5_t-BnFAE	c-d5Elo(Ot_GA3)
LBAIID (n=1)	1.1	1.0					1.0	1.0	1.2		1.0			1.1
LBAPPG (n=1)	1.0	1.0					1.0	1.0	1.2		1.1			0.9

Table 106: Fatty acid profiles of T2 seeds harvested from homozygous T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc The events are indicated in the first column, along with the number of T2 seed batches that where measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBAIID (n=20)	5.1 ± 0.2	0.2 ± 0	0 ± 0	3.6 ± 0.3	23.6 ± 1.8	38.4 ± 0.9	0.5 ± 0.1	4.9 ± 0.3	2.1 ± 0.2	0.5 ± 0.1	0.9 ± 0.1	0.6 ± 0	0.1 ± 0	0.1 ± 0	1.2 ± 0.1	0.9 ± 0.1	1.8 ± 0.2	8.1 ± 0.8	0.4 ± 0	0 ± 0	0.7 ± 0.1	1.8 ± 0.2	0.8 ± 0.1	3.4 ± 0.4	0.3 ± 0.1	0 ± 0
LBAPPG (n=18)	5.6 ± 0.5	0.3 ± 0.1	0 ± 0	4.3 ± 0.3	24.2 ± 2.7	39.9 ± 1.2	0.3 ± 0.1	4.7 ± 0.3	2 ± 0.3	0.4 ± 0.1	1 ± 0.1	0.6 ± 0	0.1 ± 0	0 ± 0	1 ± 0.1	0.7 ± 0.2	1.8 ± 0.2	6.9 ± 1.2	0.4 ± 0	0 ± 0	0.6 ± 0.1	1.6 ± 0.2	0.6 ± 0.2	2.9 ± 0.5	0 ± 0.1	0 ± 0

Table 107: Fatty acid profiles of one T2 seed batch per event harvested from homozygous T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. The events are indicated in the first column. Fatty acid profiles of

T2 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBAIID (n=1)	5.2	0.3	0.0	3.7	20.9	37.3	0.4	5.3	2.4	0.6	0.9	0.6	0.1	0.1	1.0	0.8	2.0	9.2	0.4	0.0	0.8	2.2	1.0	4.5	0.3	0.0
LBAPPG (n=1)	4.9	0.2	0.0	4.6	22.3	38.8	0.3	4.7	2.1	0.5	1.2	0.7	0.1	0.0	1.2	0.9	2.0	8.2	0.5	0.0	0.6	1.8	0.7	3.7	0.0	0.0

Table 108: Fatty acid profiles of T2 seeds harvested from homozygous T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LJB2755-2qcz rc and VC-LTM217-1qcz rc. Plants of all events combined have been grouped into the category “sc”. The number of T1 plants fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=38)	2.6 ± 0.2	0.1 ± 0	0 ± 0	2 ± 0.2	12 ± 1.1	19.5 ± 0.6	0.2 ± 0	2.4 ± 0.1	1 ± 0.1	0.2 ± 0	0.5 ± 0	0.3 ± 0	0 ± 0	0 ± 0	0.5 ± 0.1	0.4 ± 0.1	0.9 ± 0.1	3.7 ± 0.6	0.2 ± 0	0 ± 0	0.3 ± 0	0.8 ± 0.1	0.3 ± 0.1	1.6 ± 0.3	0.1 ± 0.1	0 ± 0

Example 15: Plants containing the T-DNA of plasmid RTP10690-1qcz_F for production of EPA and DHA in seeds

All genetic elements required for EPA and DHA synthesis described in this example, were transferred on a single T-DNA using a BiBAC plasmid into the plant genome. To this end, the plasmid RTP10690-1qcz_F was cloned into agrobacteria, and plant tissue was incubated according to example 6 with this agrobacterial culture. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of RTP10690-1qcz_F. The genetic elements of RTP10690-1qcz_F and the function of each element are listed in Table 8. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of RTP10690-1qcz_F that required for EPA and DHA synthesis are additionally listed Table 109.

Table 109: List of genes essential of EPA and DHA synthesis carried by the T-DNA of plasmid RTP10690-1qcz_F.

Genes encoding enzmyes for EPA and DHA synthesis	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA2)	1197	Delta-12 desaturase from *Phythophthora sojae*
c-d6Des(Ot_febit)	1371	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Pp_GA2)	873	Delta-6 elongase from *Physcomitrella patens*
c-d6Elo(Tp_GA2)	819	Delta-6 elongase from *Thalassiosira pseudonana*
c-d5Des(Tc_GA2)	1320	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
2 copies of c-d5Des(Tc_GA2)	1320	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	1086	Omega-3-desaturase from *Phythophthora infestans*
2 copies of c-o3Des(Pir_GA)	1092	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	903	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Pl_GA)2	1338	Delta-4 desaturase from *Pavlova lutheri*
c-d4Des(Tc_GA3)	1560	Delta-4 desaturase from *Thraustochytrium* sp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNA of plasmids RTP10690-1qcz_F cultivated in greenhouses during winter

As Table 110 indicates there were fewer insertion events of this construct observed than for other constructs, with more single copy events than double copy, by approximately four fold. Fatty acid profile data on Table 111 and Table 112 indicated that DHA and EPA can accumulate up to 4% of the total seed fatty acid content in the T1 with similar performance between single and double copy events, within error. Table 113 demonstrates that there was no significant aerial phenotype associated with this construct in the T0.

Table 110: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49.

	Copy number assays targeting the T-DNA of RTP10690-1qcz_F. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA)near the right T-DNA border.													
Category of T0 plants	c-AHAS	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss2_c-d4Des(Tc_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-i-Atss2_c-d4Des(Pl_GA)-195R	j-p-LuPXR_i-Atss15	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)
sc (n=52)	1.1	2.0	1.2	1.0	1.1	1.0		1.0	1.2	1.0	1.1	1.0	2.0	1.1
dc (n=12)	1.6	3.5	2.0	1.8	1.9	2.0		1.9	2.2	1.8	2.1	1.8	3.5	1.8

Table 111: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 110. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=52)	5.1 ± 0.7	0.3 ± 0.1	0 ± 0	3.1 ± 0.4	43.8 ± 7.3	28.3 ± 4.5	0.3 ± 0.2	5.1 ± 0.8	0.8 ± 0.4	0.1 ± 0.1	0.9 ± 0.1	1 ± 0.1	0.5 ± 0.6	0.2 ± 0.3	2.2 ± 0.7	1.1 ± 0.4	1.6 ± 0.5	3.2 ± 1	0.4 ± 0.1	0 ± 0	0.1 ± 0.1	1.1 ± 0.4	0 ± 0	0.5 ± 0.3	0.1 ± 0.1	0.2 ± 0.2
dc (n=12)	5.2 ± 0.4	0.3 ± 0.1	0 ± 0.1	3.5 ± 0.5	39 ± 6.7	30.1 ± 3	0.5 ± 0.2	4.5 ± 0.6	1.6 ± 0.6	0.2 ± 0.1	0.9 ± 0.1	0.9 ± 0.1	0.3 ± 0.4	0.1 ± 0.1	3.1 ± 1	1.2 ± 0.4	2 ± 1.4	3.7 ± 1.3	0.4 ± 0	0 ± 0	0.3 ± 0.2	1.2 ± 0.4	0 ± 0	0.7 ± 0.3	0.2 ± 0.2	0.1 ± 0.2

Table 112: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories

indicated in the first column as described in Table 110. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	5.5	0.3	0.0	4.1	27.2	33.6	0.7	4.1	1.9	0.3	0.9	0.7	0.3	0.2	4.5	2.1	2.7	5.8	0.4	0.0	0.3	2.2	0.1	1.4	0.4	0.2
dc (n=1)	5.3	0.3	0.0	3.8	31.9	32.9	0.6	3.8	1.6	0.2	0.9	0.8	0.4	0.2	3.6	1.5	2.7	5.7	0.4	0.0	0.3	1.7	0.0	1.1	0.2	0.3

Table 113: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. Considering each event was in this generation represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 110. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
sc (n=52)	61.4 ± 15.5	8.7 ± 1.2	8.7 ± 1.2	8.8 ± 0.9	7.6 ± 2.5	3 ± 0	5.4 ± 7.9	5.9 ± 6.9	7.3 ± 2.6	4.9 ± 1.3	123.8 ± 7.5			35.4 ± 2.4	30.1 ± 1.1
dc (n=12)	56.3 ± 9.6	9 ± 0	9 ± 0	9 ± 0	8.1 ± 2.1	3 ± 0	4.3 ± 1	5 ± 0	8.1 ± 2.1	5 ± 0.9	125.4 ± 5.4			34.8 ± 1.1	29.9 ± 1

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNA of plasmids RTP10690-1qcz_F cultivated in greenhouses during summer

Data in Table 115 and Table 116 indicate a similar performance of the T2 seed as that of the T1 seed with respect to EPA and DHA, see also Table 111 and Table 112 for comparison. The selected events all performed at a similar level and segregated for one to two copies of each gene.

Table 114: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that were measured per event.

	Copy number assays targeting the T-DNA of RTP10690-1qcz_F. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA)near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity of all plants per event was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.													
Event	c-AHAS	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss2_c-d4Des(Tc_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-i-Atss2_c-d4Des(Pl_GA)-	j-p-LuPXR_i-Atss15	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)
LBDGCA (n=94)	1.5 (T0: 1)	3.2 (T0: 2)	1.6 (T0: 1.4)	(T0: 1)	(T0: 1.2)	1.7 (T0: 0.9)	1.6	1.6 (T0: 1)	(T0: 1.2)	1.7 (T0: 1)	(T0: 1.1)	(T0: 1.1)	3.2 (T0: 2)	1.6 (T0: 1)
LBDGBP (n=20)	(T0: 1.1)	(T0: 2.1)	(T0: 1.4)	(T0: 1.2)	(T0: 1.3)	(T0: 1.1)		(T0: 1.1)	(T0: 1.3)	(T0: 1)	(T0: 1)	(T0: 1.2)	(T0: 2.1)	(T0: 1)
LBDIHN (n=114)	1.6 (T0: 1.2)	3.3 (T0: 2.2)	1.6 (T0: 1.7)	(T0: 1.1)	(T0: 1.2)	1.7 (T0: 1)	1.6	1.6 (T0: 1.1)		1.7 (T0: 1)	(T0: 0.9)	(T0: 1.2)	3.3 (T0: 2.2)	1.6 (T0: 1.1)

Table 115: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that were measured per event.

event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBDGCA (n=90)	5.7 ± 0.5	0.2 ± 0.1	0 ± 0.1	4.1 ± 0.7	36.4 ± 7.3	32.5 ± 3.9	0.5 ± 0.2	4.5 ± 0.9	1.7 ± 0.7	0.2 ± 0.1	1.1 ± 0.2	0.8 ± 0.1	0.2 ± 0.1	0 ± 0	2.6 ± 0.6	1 ± 0.2	1.9 ± 0.7	3.3 ± 1.2	0.4 ± 0.1	0 ± 0	0.4 ± 0.2	1.4 ± 0.5	0 ± 0	0.6 ± 0.3	0.3 ± 0.1	0.1 ± 0.1
LBDGBP (n=20)	5.4 ± 0.5	0.3 ± 0	0 ± 0	3.9 ± 0.4	25.4 ± 2.3	37.1 ± 1.6	0.5 ± 0	3.4 ± 0.2	2.4 ± 0.3	0.2 ± 0	1 ± 0.1	0.6 ± 0	0.1 ± 0	0 ± 0	2.3 ± 0.2	0.9 ± 0.2	3.8 ± 0.5	7.5 ± 1.6	0.4 ± 0	0 ± 0	0.6 ± 0.1	2.4 ± 0.4	0 ± 0.2	1.7 ± 0.7	0 ± 0	0 ± 0
LBDIHN (n=110)	4.9 ± 0.4	0.2 ± 0.1	0 ± 0	3.6 ± 0.5	32.5 ± 7.6	34.5 ± 4.1	0.6 ± 0.2	4.4 ± 1	1.7 ± 0.7	0.2 ± 0.1	0.9 ± 0.1	0.8 ± 0.1	0.3 ± 0.2	0.1 ± 0.1	2.3 ± 0.4	1.1 ± 0.4	2.7 ± 0.9	5.2 ± 1.6	0.4 ± 0.1	0 ± 0	0.4 ± 0.2	1.9 ± 0.6	0 ± 0	0.9 ± 0.4	0.2 ± 0.1	0.1 ± 0.1

Table 116: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T2 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Events	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBDGCA (n=1)	5.5	0.2	0.0	3.3	29.2	31.8	0.9	5.3	2.8	0.4	0.7	0.7	0.1	0.1	2.9	1.2	3.6	5.9	0.3	0.0	0.6	2.6	0.0	1.3	0.4	0.1
LBDGBP (n=1)	5.2	0.3	0.0	3.9	20.3	35.1	0.5	3.6	2.7	0.3	1.0	0.6	0.1	0.0	2.6	1.3	4.4	10.8	0.4	0.0	0.7	3.3	0.0	3.0	0.0	0.0
LBDIHN (n=1)	5.0	0.3	0.0	3.5	23.8	36.3	0.6	2.6	2.6	0.2	0.9	0.6	0.1	0.0	2.8	1.1	4.1	9.1	0.4	0.0	1.0	2.8	0.0	2.1	0.0	0.1

Table 117: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid RTP10690-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that were measured per event. Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Events	Oil	Protein
LBDGCA (n=90)	34.1 ± 3.1	30.1 ± 1.9
LBDIHN (n=110)	35.3 ± 2.7	29.9 ± 1.8

Example 16: Plants containing the T-DNA of plasmid RTP10691-2qcz for production of EPA and DHA in seeds

All genetic elements required for EPA and DHA synthesis described in this example, were transferred on a single T-DNA using a BiBAC plasmid into the plant genome. To this end, the plasmid RTP10691-2qcz was cloned into agrobacteria, and plant tissue was incubated according to example 6 with this agrobacterial culture. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of RTP10691-2qcz. The genetic elements of RTP10691-2qcz and the function of each element are listed in Table 9. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of RTP10691-2qcz that required for EPA and DHA synthesis are additionally listed in Table 118.

Table 118: List of genes essential of EPA and DHA synthesis carried by the T-DNA of plasmid RTP10691-2qcz.

Genes encoding enzmyes for EPA and DHA synthesis	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA2)	1196	Delta-12 desaturase from *Phythophthora sojae*
c-d6Des(Ot_febit)	1371	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Pp_GA2)	873	Delta-6 elongase from *Physcomitrella patens*
c-d6Elo(Tp_GA2)	819	Delta-6 elongase from *Thalassiosira pseudonana*
2 copies of c-d5Des(Tc_GA2)	1320	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	1086	Omega-3-desaturase from *Phythophthora infestans*
2 copies of c-o3Des(Pir_GA)	1092	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	903	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Pl_GA)2	1337	Delta-4 desaturase from *Pavlova lutheri*
c-d4Des(Tc_GA3)	1560	Delta-4 desaturase from *Thraustochytrium* sp.

Example 17: Plants containing the T-DNA of plasmid VC-LTM595-1qcz rc for production of EPA and DHA in seeds

All genetic elements required for EPA and DHA synthesis described in this example, were transferred on a single T-DNA using a BiBAC plasmid into the plant genome. To this end, the plasmid VC-LTM595-1qcz rc was cloned into agrobacteria, and plant tissue was incubated according to example 6 with this agrobacterial culture. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of VC-LTM595-1qcz rc. The genetic elements of VC-LTM595-1qcz rc and the function of each element are listed in Table 10. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LTM595-1qcz rc that required for EPA and DHA synthesis are additionally listed Table 119.

Table 119: List of genes essential of EPA and DHA synthesis carried by the T-DNA of plasmid VC-LTM595-1qcz rc.

Genes encoding enzmyes for EPA and DHA synthesis	Length (bp)	Enzymatic function and source of encoded protein
c-d12Des(Ps_GA2)	1197	Delta-12 desaturase from *Phythophthora sojae*
c-d6Des(Ot_febit)	1371	Delta-6 desaturase from *Ostreococcus tauri*
c-d6Elo(Pp_GA2)	873	Delta-6 elongase from *Physcomitrella patens*
c-d6Elo(Tp_GA2)	819	Delta-6 elongase from *Thalassiosira pseudonana*
c-d5Des(Tc_GA2)	1320	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-d5Des(Tc_GA2)	1320	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685
c-o3Des(Pi_GA2)	1086	Omega-3-desaturase from *Phythophthora infestans*
2 copies of c-o3Des(Pir_GA)	1092	Omega-3 desaturase from *Pythium irregulare*
c-d5Elo(Ot_GA3)	903	Delta-5 elongase from *Ostreococcus tauri*
c-d4Des(Pl_GA)2	1338	Delta-4 desaturase from *Pavlova lutheri*
c-d4Des(Tc_GA3)	1560	Delta-4 desaturase from *Thraustochytrium* sp.

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNA of plasmids VC-LTM595-1qcz rc cultivated in greenhouses during summer

Similar to VC-RTP10690-1qcz_F, the number of insertions of the entire T-DNA was not as high as obtained for the multi-construct transformations, see Table 120. Table 121 and Table 122 show the fatty acid profile measurements for single, double and triple copy T-DNA, and indicate that the double copy constructs perform marginally better than the single copy constructs and perhaps marginally better than the triple copy constructs in terms of EPA and DHA accumulation. The fatty acid profile data further indicate that the accumulation of EPA and DHA in the T1 seed was up to 10% of the total fatty acids with up to 2% of the total fatty acids in the seed being DHA. Phenotypic measurements, shown on Table 123, indicated some variability in flowering time (as represented by DFF).

Table 120: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table except the assay c-d5Des(Tc_GA) was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49, tc: all T0 plants where the average of all copy number assays listed in this table was 2.51-3.49.

	Copy number assays targeting the T-DNA of VC-LTM595-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA) near the right T-DNA border.													
Category of T0 plants	c-AHAS	j-p-BnSETL-v1_c-o3Des(Pir_GA)	c-d4Des(Pl_GA)2	j-i-Atss18_c-o3Des(Pi_GA2)	j-p-PvARC5_t-BnFAE	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d5Des(Tc_GA)	j-p-LuPXR_i-Atss15	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)
sc (n=24)	1.1		1.0	1.0	0.9	0.9	1.9	1.1		1.0	0.9	1.1	1.9	1.0
dc (n=7)	2.2		2.3	2.1	2.0	1.9	3.8	2.3		2.2	2.3	2.1	3.8	1.9
tc (n=3)	2.4		2.4	1.9	2.5	2.0	4.6	3.3		2.4	2.9	2.4	4.6	2.4

Table 121: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 120. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=24)	5.2 ± 0.6	0.3 ± 0.1	0 ± 0	3 ± 0.4	41.2 ± 4.8	28.6 ± 2.3	0.3 ± 0.1	5.9 ± 0.6	0.6 ± 0.3	0.1 ± 0.1	0.8 ± 0.1	0.9 ± 0.1	0.6 ± 0.3	0.3 ± 0.1	1.9 ± 0.7	1.2 ± 0.5	1.5 ± 0.3	3.5 ± 0.8	0.4 ± 0.1	0 ± 0	0.3 ± 0.1	1.2 ± 0.3	0 ± 0.1	1.1 ± 0.3	0.4 ± 0.2	0.3 ± 0.2
dc (n=7)	5.6 ± 1.4	0.3 ± 0.2	0 ± 0	3.7 ± 0.7	34.4 ± 7.3	31.2 ± 3.4	0.4 ± 0.2	5.7 ± 1.4	1.5 ± 0.5	0.2 ± 0.2	0.9 ± 0.2	0.8 ± 0.2	0.3 ± 0.2	0.1 ± 0.1	2.7 ± 0.8	1.5 ± 1	1.6 ± 0.8	3.8 ± 2.2	0.4 ± 0	0 ± 0	0.6 ± 0.4	1.5 ± 0.8	0.2 ± 0.1	1.6 ± 0.6	0.7 ± 0.1	0.2 ± 0.1
tc (n=3)	4.1 ± 1.3	0.2 ± 0.1	0 ± 0	3 ± 0.1	45.4 ± 8.4	26.2 ± 2.2	0.4 ± 0.3	6 ± 0.9	1.7 ± 2	0.2 ± 0.3	0.8 ± 0	1 ± 0.1	0.3 ± 0.2	0.1 ± 0.1	1.5 ± 0.4	0.7 ± 0.1	1.5 ± 0.7	3.3 ± 1.6	0.4 ± 0	0 ± 0	0.5 ± 0.3	1 ± 0.4	0.2 ± 0.1	1.1 ± 0.5	0.3 ± 0.1	0.2 ± 0.1

Table 122: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 120. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	6.3	0.4	0.0	3.4	34.6	29.8	0.4	5.3	1.0	0.1	0.8	0.8	0.6	0.3	2.9	1.6	1.8	4.6	0.3	0.0	0.5	1.6	0.2	1.6	0.7	0.3
dc (n=1)	4.9	0.2	0.0	2.8	25.8	33.9	0.3	4.8	1.7	0.3	0.7	0.7	0.5	0.2	3.2	1.7	2.8	7.4	0.4	0.0	1.2	2.9	0.2	2.3	0.8	0.3
tc (n=1)	4.5	0.2	0.0	3.1	37.8	28.0	0.7	5.7	3.9	0.5	0.8	0.9	0.1	0.0	1.6	0.6	1.8	4.8	0.4	0.0	0.8	1.3	0.3	1.5	0.4	0.1

Table 123: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. Considering each event in this generation was represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 120. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong

dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC
sc (n=24)	44.8 ± 17.3	9 ± 0	8.7 ± 1.1	9 ± 0	6.7 ± 2.4	3 ± 0	4.7 ± 0.8	5 ± 0	6.7 ± 2.4	4.7 ± 1	123.5 ± 7.7	4.4 ± 0.5	1.6 ± 0.9
dc (n=7)	47.1 ± 10.3	9 ± 0	8.7 ± 0.8	9 ± 0	4.7 ± 2.6	3 ± 0	5 ± 0	5 ± 0	4.7 ± 2.6	4.7 ± 1.1	122.9 ± 5.7	4.3 ± 0.9	2.1 ± 1.5
tc (n=3)	42.3 ± 2.5	9 ± 0	9 ± 0	9 ± 0	6 ± 4.4	3 ± 0	5 ± 0	5 ± 0	6 ± 4.4	5 ± 1.7	125 ± 10	4.2 ± 0.2	4.3 ± 3.2

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNA of plasmids VC-LTM595-1qcz rc cultivated in greenhouses during winter

The data Table 124, Table 125 and Table 126 indicate that a variety of copy numbers for the genes contained on the T-DNA were obtained, with copy number values ranging from 1 to 3. The performance of the events selected for measurements of fatty acid profiles (see Table 127 and Table 128) was similar to that observed in the previous example with the EPA and DHA combined value being approximately ten percent of the total fatty acid content of the seed, for the upper end of values. The data in Table 129 indicate, as observed in prior generations for this construct (see example 17 part A), that there was some variation in flowering time among the various events.

Table 124: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM595-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. The T1 plants underwent a selection from 250 segregating T1 seedlings, using zygosity analysis as illustrated in Table 125, keeping only plants that are homozygous for the desired number of loci (which are indicated in the last column of Table 125). A copy number of ~2 therefore was indicative for one homozygous copy, a copy number of ~4 indicative for two homozygous copies (located either at on or at two different loci) and so forth. Odd results of 3, 5, 7, 9 etc indicate that at least some of the selected T1 plants carry at least one heterozygous locus. Homozygosity was indicated if the average result of the selected T1 plants was about two fold higher than the the result oberved in the T0 generation (indicated in parentheses). For some events this was not the case because during selection of T1 plants, undesired loci have been segregated out while retaining only desired loci in a homozygous state.

Event	Copy number assays targeting the T-DNA of VC-LTM595-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA) near the right T-DNA border.														
	c-AHAS	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss2_c-d4Des(Tc_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-i-Atss2_c-d4Des(Pl_GA)-195R	j-p-LuPXR_i-Atss15	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)	Conclusion from individual assays: number of T-DNA copies inserted into the genome
LBEDTZ	4.1 (T0: 2.2)	4	4 (T0: 2)	4 (T0: 1.8)	(T0: 1.8)	4.3 (T0: 1.8)	8.1 (T0: 3.8)	3.8 (T0: 2.5)	5.7	5 (T0: 2.8)	4.7 (T0: 2.8)	5.5 (T0: 3.1)	8.1 (T0: 3.8)	4.1 (T0: 2)	partial double copy
LBEDUA	4.3 (T0: 2.7)	4.2	4 (T0: 2.3)	3 (T0: 2.2)	(T0: 2)	4.5 (T0: 2.3)	8 (T0: 4)	4 (T0: 2.4)	4.3	3.7 (T0: 2.2)	3.6 (T0: 2.4)	4 (T0: 2.1)	8 (T0: 4)	3.8 (T0: 2.4)	partial double copy
LBEDWU	4.2 (T0: 1.8)	3.4	3.3 (T0: 1.9)	2.7 (T0: 1.6)	(T0: 1.7)	3.6 (T0: 1.7)	6.7 (T0: 3.5)	3.2 (T0: 1.9)	3.2	3.3 (T0: 1.7)	3 (T0: 1.7)	3.3 (T0: 1.8)	6.7 (T0: 3.5)	3.9 (T0: 2.1)	partial double copy
LBEFME	(T0: 2.6)		(T0: 2.5)	(T0: 2.6)	(T0: 2.4)		(T0: 3.7)	(T0: 3)		(T0: 2.4)	(T0: 2.7)	(T0: 2)	(T0: 3.7)	(T0: 1.1)	partial double copy
LBEEIL	(T0: 2.4)		(T0: 2.7)	(T0: 2.5)	(T0: 2.5)		(T0: 3.7)	(T0: 2)		(T0: 1.9)	(T0: 2)	(T0: 1.8)	(T0: 3.7)	(T0: 2.1)	partial double copy
LBEEBO	(T0: 2.1)		(T0: 2.7)	(T0: 1.8)	(T0: 1.6)	(T0: 1.9)	(T0: 3.6)	(T0: 1.9)		(T0: 2)	(T0: 2.1)	(T0: 1.8)	(T0: 3.6)	(T0: 2.1)	partial double copy
LBERLW	(T0: 2.1)		(T0: 1.4)	(T0: 1.7)	(T0: 1.6)		(T0: 2.6)	(T0: 2)		(T0: 1.2)	(T0: 0.9)	(T0: 1.6)	(T0: 2.6)	(T0: 1.6)	partial double copy

Table 125: Observed Medelian segregation of the genotype of T1 seeds of events from construct VC-LTM595-1qcz rc. The segregation has been analysed at three positions of the T-DNA. For each position, the number of seedlings have been counted that have a copy number (arithmetically rounded) of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. The of seedlings counted for each copy number category are separated by colon, displaying the categories in the following order: 0 : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12. Listed are the observed copy number segregation ratios for T1 seeds segregating for one or more unlinked genomic loci, which contain one or more linked copies of T-DNA insertions. The observed frequencies for each assay have been compared against expected frequencies for various locus configurations listed in Table 136 using Chi-Square analysis. The last column displays the total number of loci that are segregating in the genome of a given event. Many events contain truncated insertions, as was evident when some assays indicate single copy insertion at e.g. the left border (e.g. event LBEDTZ), while other position on the T-DNA clearly indicate a double copy insertion that are either inserted in one locus (e.g. event LBEDTZ), or in two loci (e.g. event LBEDWU)

Event	Copy number ratios measured near the left border of the T-DNA using an assay targetting c-AHAS	Copy number ratios measured using T-DNA internal assays targeting reagions that had copy number results indicating truncated T-DNA insertions using assay A04 (target: j-i-Atss18_c-o3Des(Pi_GA2)), or A10 (target: c-d6Elo(Tp_GA)), or A11 (target j-t-StCAT_p2_p-LuPXR)	Copy number ratios measured near the right border of the T-DNA using an assay targetting c-d6Elo(Pp_GA)	Most likely number of loci containing one or more T-DNA copies, tested using Chi-Square test
LBEDTZ	084:001:111:002:050:000:000:000:000:000:000:000:000	A10: 085:000:001:111:002:048:002:000:000:000:000:000:000	084:000:111:000:052:001:000:000:000:000:000:000:000	single locus
LBEDUA				double locus
LBEDWU	023:071:098:043:014:000:000:000:000:000:000:000:000	A10: 023:075:098:048:004:000:000:000:000:000:000:000:000	023:071:099:045:011:000:000:000:000:000:000:000:000	double locus
LBEFME	011:025:039:062:040:041:023:005:001:000:000:001:000	A11: 010:024:043:063:073:027:004:001:001:000:000:000:000	059:137:052:000:000:000:000:000:000:000:000:000:000	triple locus
LBEEIL	075:020:044:051:039:018:001:000:000:000:000:000:000	A04: 073:020:046:050:046:010:001:000:000:000:000:000:000	075:020:043:052:039:017:002:000:000:000:000:000:000	triple locus
LBEEBO	019:072:090:055:012:000:000:000:000:000:000:000:000	A10: 019:073:090:052:015:000:000:000:000:000:000:000:000	065:118:059:007:000:000:000:000:000:000:000:000:000	double locus
LBERLW	012:039:057:058:050:023:010:000:000:000:000:000:000	A10: 010:046:065:034:009:000:000:000:000:000:000:000:000	011:072:096:054:014:000:000:000:000:000:000:000:000	double locus

Table 126: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that were measured per event.

	Copy number assays targeting the T-DNA of VC-LTM595-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA)near the right T-DNA border. Copy number results obtained on the T0 plants are indicated in parentheses. Homozygosity of all plants per event was indicated if the average result of the selected T1 plants was about two fold higher than the T0 generation.													
Event	c-AHAS	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss2_c-d4Des(Tc_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-i-Atss2_c-d4Des(Pl_GA)-195R	j-p-LuPXR_i-Atss15	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Otfebit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)
LBDGCA (n=94)	1.5 (T0: 1)	3.2 (T0: 2)	1.6 (T0: 1.4)	(T0: 1)	(T0: 1.2)	1.7 (T0: 0.9)	1.6	1.6 (T0: 1)	(T0: 1.2)	1.7 (T0: 1)	(T0: 1.1)	(T0: 1.1)	3.2 (T0: 2)	1.6 (T0: 1)
LBDGBP (n=20)	(T0: 1.1)	(T0: 2.1)	(T0: 1.4)	(T0: 1.2)	(T0: 1.3)	(T0: 1.1)		(T0: 1.1)	(T0: 1.3)	(T0: 1)	(T0: 1)	(T0: 1.2)	(T0: 2.1)	(T0: 1)
LBDIHN (n=114)	1.6 (T0: 1.2)	3.3 (T0: 2.2)	1.6 (T0: 1.7)	(T0: 1.1)	(T0: 1.2)	1.7 (T0: 1)	1.6	1.6 (T0: 1.1)		1.7 (T0: 1)	(T0: 0.9)	(T0: 1.2)	3.3 (T0: 2.2)	1.6 (T0: 1.1)

Table 127: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that were measured per event.

event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBEDTZ (n=34)	4.9 ± 0.2	0.2 ± 0	0 ± 0	2.4 ± 0.2	28 ± 1.7	31.1 ± 2.2	1.3 ± 0.2	4.9 ± 0.5	4.9 ± 2	0.8 ± 0.3	0.8 ± 0.1	0.7 ± 0.1	0.1 ± 0.1	0.1 ± 0	3.9 ± 0.8	1.5 ± 0.5	2.4 ± 0.4	4.7 ± 1.6	0.4 ± 0	0 ± 0	0.9 ± 0.1	1.8 ± 0.6	0.8 ± 0.1	1.7 ± 0.6	1.2 ± 0.3	0.2 ± 0.1
LBEDUA (n=4)	7.7 ± 0.2	0.4 ± 0.1	0 ± 0	3.6 ± 0.5	24.3 ± 0.7	32.6 ± 1	0.9 ± 0.1	4.1 ± 0.4	2.4 ± 0.2	0.3 ± 0	1.1 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	3.9 ± 0.6	1.4 ± 0.1	2.2 ± 0.2	6.5 ± 0.3	0.5 ± 0	0 ± 0	1.1 ± 0	1.8 ± 0.2	0.7 ± 0.1	2.5 ± 0.1	0.8 ± 0.1	0.1 ± 0
LBEDWU (n=6)	6.4 ± 0.4	0.3 ± 0.1	0 ± 0	5.1 ± 0.9	26.4 ± 3.4	31.5 ± 1.2	0.8 ± 0.2	4.4 ± 0.2	2.1 ± 0.5	0.3 ± 0.1	1.4 ± 0.2	0.7 ± 0.1	0.1 ± 0	0.2 ± 0.1	3.3 ± 0.3	1.4 ± 0.2	1.7 ± 0.2	6.1 ± 1.4	0.6 ± 0.1	0 ± 0	1 ± 0.2	1.8 ± 0.4	0.6 ± 0.2	2.6 ± 0.5	0.9 ± 0.2	0.1 ± 0

Table 128: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. For each

event, the fatty acid profile of the plant having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Events	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBEDTZ (n=1)	4.9	0.2	0.0	2.5	26.4	27.0	1.3	5.6	2.2	0.3	0.8	0.7	0.1	0.1	4.3	2.4	2.0	8.5	0.3	0.0	0.9	3.2	0.9	3.3	1.7	0.3
LBEDUA (n=1)	8.0	0.4	0.0	3.9	23.6	32.3	0.9	4.2	2.1	0.2	1.2	0.7	0.1	0.1	3.9	1.5	2.2	6.7	0.5	0.0	1.1	2.0	0.7	2.7	0.9	0.1
LBEDWU (n=1)	6.1	0.3	0.0	4.9	22.2	32.8	0.8	4.8	1.9	0.3	1.2	0.6	0.1	0.1	3.0	1.4	1.7	7.7	0.5	0.0	1.3	2.5	0.9	3.4	1.2	0.1

Table 129: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM595-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Events	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
LBEDTZ (n=34)	46.7 ± 3.7	8.9 ± 0.5	7.8 ± 0.6	7.9 ± 0.4	8.8 ± 0.7	3 ± 0	4 ± 0	5 ± 0	9 ± 0	5.2 ± 0.6	102.6 ± 7.1	3.4 ± 1.2	3.7 ± 1.1	36.3	30.5
LBEDUA (n=4)	60.8 ± 2.6	5.3 ± 1.5	8 ± 0	3.8 ± 0.5	5.5 ± 0.6	3 ± 0	5 ± 0	5 ± 0	6.3 ± 0.5	4.5 ± 0.6	83.8 ± 2.5	3.7 ± 0	8 ± 0.8	32.4	30.9
LBEDWU (n=6)	47.2 ± 2.7	6 ± 0	8 ± 0	3.5 ± 0.8	5.8 ± 0.4	3 ± 0	4 ± 0	4.8 ± 0.4	6.7 ± 1.8	4.3 ± 0.5	71.7 ± 12.1	2.5 ± 0.3	6.7 ± 2.1	33.8	30.0

Example 18: Plants containing the T-DNA of plasmid VC-LTM593-1qcz rc for production of EPA and DHA in seeds

All genetic elements required for EPA and DHA synthesis described in this example, were transferred on a single T-DNA using a BiBAC plasmid into the plant genome. To this end, the plasmid VC-LTM593-1qcz rc where cloned into agrobacteria, and plant tissue was incubated according to example 6 with this agrobacterial culture. Due to the selectable herbicide resistance marker, regenerated plants contained the T-DNA of VC-LTM593-1qcz rc . The genetic elements of VC-LTM593-1qcz rc and the function of each element are listed in Table 11. For convenience, all enzymes expressed in seeds of plants carrying both T-DNA of VC-LTM593-1qcz rc that are required for EPA and DHA synthesis are additionally listed Table 130.

Table 130: List of genes essential of EPA and DHA synthesis carried by the T-DNA of plasmid VC-LTM593-1qcz rc . Preferred polynucleotide and protein sequences are shown in column 4 and 5.

Genes encoding enzmyes for EPA and DHA synthesis	**Length (bp)**	**Enzymatic function and source of encoded protein**	**Polynucleotide SEQ ID NO:**	**Protein sequence SEQ ID NO**
c-d12Des(Ps_GA2)	1197	Delta-12 desaturase from *Phythophthora sojae*	265	266
c-d6Des(Ot_febit)	1371	Delta-6 desaturase from *Ostreococcus tauri*	261	262
c-d6Elo(Pp_GA2)	873	Delta-6 elongase from *Physcomitrella patens*	257	258
c-d6Elo(Tp_GA2)	819	Delta-6 elongase from *Thalassiosira pseudonana*	263	264
2 copies of c-d5Des(Tc_GA2)	1320	Delta-5 desaturase from *Thraustochytrium* sp. ATCC21685	259	260
c-o3Des(Pi_GA2)	1086	Omega-3-desaturase from *Phythophthora infestans*	269	270
2 copies of c-o3Des(Pir_GA)	1092	Omega-3 desaturase from *Pythium irregulare*	267	268
c-d5Elo(Ot_GA3)	903	Delta-5 elongase from *Ostreococcus tauri*	275	276
c-d4Des(Pl_GA)2	1338	Delta-4 desaturase from *Pavlova lutheri*	273	274
c-d4Des(Tc_GA3)	1560	Delta-4 desaturase from *Thraustochytrium* sp.	271	272

Fatty acid profiles, copy number measurements, and phenotypic observations of T0 plants carrying T-DNAs of plasmid VC-LTM593-1qcz rc cultivated in greenhouses during summer

One observation from the data on Table 131 was that there was a higher number of insertion events obtained from VC-LTP593-1qcz than obtained from the BiBAC constructs in examples 16 or 17. The data on Table 132 and Table 133 indicate that with respect to VLC-PUFA accumulation, in particular EPA and DHA, double copy events accumulated more than single copy events and that triple copy events accumulated more than double copy events, with accumulation for the triple copy events being approximately eight percent of total fatty acids (EPA and DHA combined, with 1.6% accumulation of total fatty acids being DHA). The highest amount accumulated was approximately fifteen percent of the total fatty acid content in the seed being EPA and DHA combined, with 3 percent of the total seed fatty acid content being DHA, see Table 133. The aerial phenotype of this construct in the T0 plant and T1 seed showed less variation than that seen in examples 16 or 17.

Table 131: Copy number measurement of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. Considering each event was in this generation represented by only 1 plant, all events have been grouped into the categories indicated in the first column; sc: all T0 plants where the average of all copy number assays listed in this table except the assay c-d5Des(Tc_GA) was 0.51-1.49, dc: all T0 plants where the average of all copy number assays listed in this table was 1.51-2.49, tc: all T0 plants where the average of all copy number assays listed in this table was 2.51-3.49.

Event	Copy number assays targeting the T-DNA of VC-LTM593-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA) near the right T-DNA border.													
	c-AHAS	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-p-LuPXR_i-Atss15	j-p-PvARC5_t-BnSETL	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-p-BnSETL-v1_c-o3Des(Pir_GA)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)
sc (n=275)	1.1	1.2	1.1	1.1	1.0	2.1	1.1			1.1	1.1	1.0	2.1	1.1
dc (n=49)	1.7	1.6	1.8	1.7	1.6	3.5	1.9			1.9	2.3	1.8	3.5	1.7
tc (n=11)	2.6		3.0	3.2	2.5	5.3	3.0			2.9	3.8	2.6	5.3	2.8

Table 132: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. Considering each event was in this generation represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 131. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=275)	5.1 ± 0.5	0.3 ± 0.1	0.1 ± 0.1	3.2 ± 0.5	41.3 ± 5.3	29.6 ± 2.9	0.4 ± 0.2	6 ± 0.9	0.8 ± 0.4	0.1 ± 0.1	0.8 ± 0.1	0.9 ± 0.1	0.4 ± 0.2	0.1 ± 0.1	2 ± 0.5	1.2 ± 0.3	1.4 ± 0.5	3.8 ± 1.2	0.3 ± 0.1	0 ± 0	0 ± 0.1	0.9 ± 0.3	0 ± 0	0.9 ± 0.3	0.1 ± 0.1	0.2 ± 0.1
dc (n=49)	5.3 ± 0.6	0.3 ± 0.1	0 ± 0	3.5 ± 0.5	34.4 ± 5.9	31 ± 2.6	0.5 ± 0.2	5.5 ± 1.1	1.5 ± 0.5	0.2 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.3 ± 0.3	0.1 ± 0.1	2.7 ± 0.8	1.5 ± 0.5	2.2 ± 1.4	5.9 ± 2.4	0.3 ± 0	0 ± 0	0.1 ± 0.1	1.3 ± 0.4	0 ± 0	1.2 ± 0.5	0.2 ± 0.2	0.2 ± 0.1
tc (n=11)	5.6 ± 0.6	0.3 ± 0.1	0 ± 0.1	3.7 ± 0.6	28 ± 5.6	31.6 ± 2.1	0.9 ± 0.4	5.1 ± 0.5	2.2 ± 0.8	0.3 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.3 ± 0.2	0.1 ± 0.1	4.7 ± 1.7	2.8 ± 1.3	1.7 ± 1.2	6.6 ± 3.7	0.3 ± 0.1	0 ± 0	0.2 ± 0.2	1.5 ± 0.7	0 ± 0	1.6 ± 0.9	0.6 ± 0.9	0.3 ± 0.1

Table 133: Fatty acid profiles of T1 seeds harvested from T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. Considering each event was in this generation represented by only 1 plant, all events have been grouped into the categories

indicated in the first column as described in Table 131. For each category, the fatty acid profile of the plant/event having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T0 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	4.7	0.2	0.2	3.2	25.1	36.0	0.6	5.0	2.2	0.3	0.7	0.6	0.4	0.1	2.6	1.3	4.1	8.6	0.2	0.0	0.2	1.8	0.0	1.6	0.0	0.2
dc (n=1)	5.4	0.2	0.0	3.1	23.8	29.4	0.5	4.9	1.8	0.2	0.7	0.7	0.8	0.1	3.5	2.2	4.1	12.3	0.3	0.0	0.2	2.7	0.0	2.4	0.1	0.5
tc (n=1)	5.7	0.2	0.1	3.7	21.5	32.7	0.6	4.8	1.9	0.3	0.9	0.6	0.9	0.4	1.8	1.3	3.0	12.4	0.4	0.0	0.5	2.6	0.1	3.2	0.0	0.4

Table 134: Phenotypic rating of T0 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. Considering each event was in this generation represented by only 1 plant, all events have been grouped into the categories indicated in the first column as described in Table 131. The number of T0 plants/events fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), Protein: Protein content (% of seed cake without oil)

Category of T0 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
sc (n=275)	56.5 ± 6.1	9 ± 0	8.6 ± 1.1	9 ± 0	5 ± 4.1	3 ± 0	4.9 ± 0.5	5 ± 0	4.8 ± 2.9	5 ± 1.1	123.9 ± 8.9	4.6 ± 0.6	1.8 ± 1.7	36.5 ± 1.1	29.1 ± 0.8
dc (n=49)	57.4 ± 6	8.9 ± 1	8.4 ± 1.4	8.9 ± 0.5	4.3 ± 2.7	3 ± 0	4.8 ± 0.8	5 ± 0	4.3 ± 2.7	5 ± 1.2	119.1 ± 15.7	4.5 ± 0.6	1.6 ± 1.2	36.2 ± 1.5	28.7 ± 1.2
tc (n=11)	60.3 ± 5.5	9 ± 0	8.5 ± 1	9 ± 0	3.5 ± 2.2	3 ± 0	5 ± 0	5 ± 0	3.5 ± 2.2	4.8 ± 1.5	125.9 ± 7	4.4 ± 0.6	3.5 ± 2.9		

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNAs of plasmids VC-LTM593-1qcz rc cultivated in greenhouses during winter

Specific events were examined further for copy number and displayed a variation in insertion number for the T-DNA from single insertion to partial double insertions along with double insertions. Additionally there were some variations in gene copy number (corresponding to the partial insertions and possible deletions), see Table 135, Table 136 and Table 137. The fatty acid profile data shown on Table 138 and Table 139 indicate an upper range of accumulation of combined EPA and DHA of eighteen percent of the total seed fatty acid content (event LBFDAU). In the event LBFDAU the percent of total seed fatty acid content being EPA is 15% and total seed fatty acid content being DHA is 3% in the T1. LBFDAU was analysed with a copy number indicative of a partial double copy. Another example of specific events having higher levels of EPA and DHA was LBFGKN with approximately 12 percent of the total seed fatty acid content being EPA and DHA, with 10 percent of the total seed fatty acid content being EPA and 2% being DHA. The T1 generation LBFGKN had only a single copy insertion event for VC-LTM593-1qcz rc, though data on Table 140, Table 141 and Table 142 indicate that double copy double locus events tended to accumulate more EPA and DHA combined than other copy and locus numbers with respect to the T2 seed fatty acid profile. This observation likely reflects the nature of insertion site effects and the various factors that affect the generation of elite events. Table 142 indicates that with respect to the aerial phenotype of the plants there was a range of flowering times, as indicated by DFF (days to the first flower) from 36-48. Event LBFDAU did not vary significantly from the majority of other events with a DFF value of 43, thus showing no significant effect on the aerial phenotype or significant impact on total oil or protein accumulation in the seed in the T1 plant and T2 seed.

Table 135: Copy number measurement of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. The T1 plants underwent a selection from 250 segregating T1 seedlings, using zygocity analysis as illustrated in Table 137, keeping only plants that are homozygous for the desired number of loci (which are indicated in the last column of Table 137). A copy number of ~2 therefore was indicative for one homozygous copy, a copy number of ~4 indicative for two homozygous copies (located either at on or at two different loci) and so forth. Odd results of 3, 5, 7, 9 etc indicate that at least some of the selected T1 plants carry at least one heterozygous locus. Homozygocity was indicated if the average result of the selected T1 plants was about two fold higher than the the result observed in the T0 generation (indicated in parentheses). For some events this was not the case because during selection of T1 plants, undesired loci have been segregated out while retaining only desired loci in a homozygous state.

Event	Copy number assays targeting the T-DNA of VC-LTM593-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA) near the right T-DNA border.														
	c-AHAS	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-p-LuPXR_i-Atss15	j-p-PvARC5_t-BnSETL	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-p-BnSETL-v1_c-o3Des(Pir_GA)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)	Conclusion from individual assays: number of T-DNA copies inserted into the genome
LBFDGG (n=50)	2.1 (T0: 1.1)	2	2 (T0: 1.3)	1.8 (T0: 1.1)	(T0: 1)	4.2 (T0: 2.2)	2 (T0: 1.1)	1.9	2	2.1 (T0: 1.1)	2.2 (T0: 1)	2.1 (T0: 1)	4.2 (T0: 2.2)	1.9 (T0: 1)	single copy
LBFGKN (n=50)	2.1 (T0: 1)	2.2	2.1 (T0: 1.3)	2.2 (T0: 1.1)	(T0: 0.8)	4.2 (T0: 2)	2.2 (T0: 1.2)	2.1	2.1	2.1 (T0: 1)	2.2 (T0: 1)	2.1 (T0: 1.1)	4.2 (T0: 2)	1.9 (T0: 1.1)	single copy
LBFIHE (n=34)	2 (T0: 1)	2.2	2.1 (T0: 1.1)	2.1 (T0: 1.2)	(T0: 1)	4.1 (T0: 1.9)	2.2 (T0: 1.1)	2.3	2.3	2.1 (T0: 1)	2.1 (T0: 1.2)	2.3 (T0: 1)	4.1 (T0: 1.9)	2.1 (T0: 1.1)	single copy
LBFLDI (n=60)	2.5 (T0: 1)	2.3	2.4 (T0: 1.1)	2.4 (T0: 1)	(T0: 1)	4.4 (T0: 1.9)	2.2 (T0: 1.2)	2.3	2.4	2.3 (T0: 0.8)	2.3 (T0: 1)	2.3 (T0: 0.9)	4.4 (T0: 1.9)	2.5 (T0: 1)	single copy
LBFPNF (n=52)	1.9 (T0: 1.1)	2.1	2.1 (T0: 1.1)	2.1 (T0: 1.3)	(T0: 1)	5.6 (T0: 2.8)	1.9 (T0: 1)	2.1	2	2 (T0: 1.2)	4 (T0: 1.9)	4.1 (T0: 1.7)	5.6 (T0: 2.8)	4.2 (T0: 1.9)	partial double copy
LBFNSQ (n=51)	2 (T0: 1.1)	2	1.9 (T0: 1.2)	1.9 (T0: 1.1)	(T0: 1.6)	7.1 (T0: 3.1)	3.8 (T0: 1.9)	4	3.9	3.7 (T0: 1.9)	4.1 (T0: 1.9)	3.8 (T0: 1.9)	7.1 (T0: 3.1)	2 (T0: 0.7)	partial double copy
LBFDGL (n=57)	2.1 (T0: 1)	2.2	3.9 (T0: 2)	3.9 (T0: 1.7)	(T0: 1.9)	6.7 (T0: 2.9)	3.8 (T0: 2)	3.8	4.1	3.8 (T0: 1.7)	4 (T0: 1.9)	3.8 (T0: 1.4)	6.7 (T0: 2.9)	1.8 (T0: 0.7)	partial double copy

LBFIEF (n=6)	4.2 (T0: 2.5)	3.7	3.6 (T0: 2.7)	3.7 (T0: 2.7)	(T0: 2)	6.4 (T0: 3.5)	3.8 (T0: 2.3)	4.2	4.1	3.6 (T0: 2.3)	3.8 (T0: 2.6)	3.7 (T0: 1.6)	6.4 (T0: 3.5)	2.1 (T0: 0.8)	partial double copy
LBFBAV (n=50)	2 (T0: 1.1)	2.2 (T0: 1.3)	3.7 (T0: 1.5)	4 (T0: 1.7)	(T0: 1.4)	8.2 (T0: 3.7)	3.8 (T0: 1.8)	3.9	3.9	4 (T0: 1.9)	3.7 (T0: 2)	4.1 (T0: 1.7)	8.2 (T0: 3.7)	6.3 (T0: 2.9)	partial double copy
LBFPNC (n=32)	2.1 (T0: 1.1)	2	2.3 (T0: 1.2)	2 (T0: 1)	(T0: 1.4)	7.5 (T0: 3.4)	4.2 (T0: 1.7)	4	3.8	3.8 (T0: 1.8)	4.1 (T0: 1.8)	4.2 (T0: 1.4)	7.5 (T0: 3.4)	4 (T0: 1.9)	partial double copy
LBFGHQ (n=46)	3.6 (T0: 1.8)	3.8	4.1 (T0: 1.8)	4 (T0: 2.2)	(T0: 1.7)	6.1 (T0: 3.1)	3.8 (T0: 1.7)	3.8	3.7	2.1 (T0: 1.1)	2 (T0: 1.1)	2 (T0: 1.1)	6.1 (T0: 3.1)	2 (T0: 1)	partial double copy
LBFAZB (n=49)	3.9 (T0: 1.8)	4 (T0: 1.7)	3.9 (T0: 1.8)	3.9 (T0: 1.7)	(T0: 1.3)	6.6 (T0: 3.1)	3.7 (T0: 1.8)	4.1	4	3.8 (T0: 1.7)	4 (T0: 1.8)	3.7 (T0: 1.3)	6.6 (T0: 3.1)	1.9 (T0: 0.6)	partial double copy
LBFGKW (n=72)	3.8 (T0: 1.8)	3.8	4.2 (T0: 2.1)	4.1 (T0: 1.9)	(T0: 1.6)	7 (T0: 3.2)	3.9 (T0: 2)	4	4	4 (T0: 1.7)	3.6 (T0: 1.8)	3.7 (T0: 1.5)	7 (T0: 3.2)	1.7 (T0: 0.6)	partial double copy
LBFNRU (n=58)	3.8 (T0: 1.9)	4	3.8 (T0: 1.9)	3.7 (T0: 2)	(T0: 1.7)	7 (T0: 3.2)	4 (T0: 1.7)	3.7	3.9	3.8 (T0: 1.7)	4.2 (T0: 1.9)	3.8 (T0: 1.6)	7 (T0: 3.2)	1.9 (T0: 0.8)	partial double copy
LBFGIZ (n=43)	3.8 (T0: 1.9)	4.1	3.9 (T0: 1.9)	3.8 (T0: 2.1)	(T0: 1.6)	7 (T0: 2.8)	4.2 (T0: 1.8)	3.8	3.9	3.8 (T0: 1.7)	4.3 (T0: 1.5)	3.8 (T0: 1.5)	7 (T0: 2.8)	1.9 (T0: 0.8)	partial double copy
LBFIGM (n=56)	4.1 (T0: 2)	3.9	3.8 (T0: 2)	3.8 (T0: 1.7)	4 (T0: 1.5)	7.6 (T0: 2.8)	3.9 (T0: 1.7)	3.9	3.8	3.8 (T0: 1.8)	4.2 (T0: 2.2)	4.1 (T0: 1.6)	7.6 (T0: 2.8)	1.9 (T0: 0.6)	partial double copy
LBFNRR (n=61)	3.7 (T0: 1.9)	4.2	4 (T0: 2.2)	3.8 (T0: 2)	(T0: 1.7)	7.1 (T0: 2.8)	4.3 (T0: 2)	3.8	4.1	3.9 (T0: 1.7)	4.3 (T0: 1.6)	3.9 (T0: 1.6)	7.1 (T0: 2.8)	1.9 (T0: 0.7)	partial double copy
LBFNTK (n=69)	4.1 (T0: 1.9)	4.1	3.9 (T0: 2.1)	3.9 (T0: 2)	4 (T0: 1.7)	7.6 (T0: 2.9)	4 (T0: 1.8)	3.9	4.1	3.8 (T0: 1.7)	4.3 (T0: 1.9)	4.1 (T0: 1.5)	7.6 (T0: 2.9)	1.9 (T0: 0.7)	partial double copy
LBFGJA (n=42)	3.7 (T0: 1.6)	3.7	3.9 (T0: 2.1)	3.6 (T0: 2.1)	(T0: 1.7)	7.6 (T0: 3.6)	3.4 (T0: 1.7)	3.8	3.7	4.1 (T0: 1.9)	3.9 (T0: 1.9)	3.6 (T0: 1.9)	7.6 (T0: 3.6)	3.9 (T0: 2.1)	double copy
LBFIFV (n=58)	3.9 (T0: 1.7)	4	3.9 (T0: 2.4)	1.9 (T0: 1)	(T0: 1.8)	7.7 (T0: 3.9)	3.9 (T0: 1.8)	3.9	4	3.9 (T0: 2)	4 (T0: 2.6)	4.2 (T0: 1.8)	7.7 (T0: 3.9)	3.9 (T0: 2)	double copy
LBFLER (n=52)	3.8 (T0: 1.9)	3.9	3.9 (T0: 2.3)	3.8 (T0: 1.9)	(T0: 1.7)	7.7 (T0: 3.3)	3.9 (T0: 2.2)	4	4	4.1 (T0: 1.8)	4.2 (T0: 2.3)	4 (T0: 1.6)	7.7 (T0: 3.3)	3.8 (T0: 1.9)	double copy
LBFLDL (n=44)	3.8 (T0: 1.7)	3.9	3.8 (T0: 2)	3.8 (T0: 1.8)	(T0: 1.8)	7.8 (T0: 3.5)	3.9 (T0: 2.1)	3.8	4.1	4.1 (T0: 1.8)	4.1 (T0: 2.1)	3.9 (T0: 1.6)	7.8 (T0: 3.5)	3.8 (T0: 1.9)	double copy
LBFNQW (n=51)	3.8 (T0: 1.8)	3.9	3.9 (T0: 1.9)	3.9 (T0: 1.9)	(T0: 1.6)	7.9 (T0: 3.4)	3.9 (T0: 1.8)	3.9	4	4.2 (T0: 1.6)	4.2 (T0: 2)	3.9 (T0: 1.9)	7.9 (T0: 3.4)	3.9 (T0: 1.8)	double copy
LBFBAP (n=19)	2 (T0: 1.1)	2 (T0: 1.2)	2 (T0: 1)	1.8 (T0: 1.3)	(T0: 1.1)	7.5 (T0: 2.8)	3.8 (T0: 1.8)	3.9	3.8	5.7 (T0: 2.3)	5.5 (T0: 2.3)	5.7 (T0: 1.8)	7.5 (T0: 2.8)	4 (T0: 2.4)	partial triple copy
LBFDAU (n=10)	2 (T0: 1.1)	2	3.8 (T0: 1.9)	3.8 (T0: 1.8)	(T0: 1.5)	7.3 (T0: 3.7)	3.8 (T0: 2)	3.9	3.9	3.7 (T0: 1.8)	3.9 (T0: 2.4)	4.1 (T0: 1.7)	7.3 (T0: 3.7)	3.7 (T0: 1.9)	partial double copy
LBFPRA (n=16)	2.1 (T0: 2)	2	6 (T0: 3)	1.8 (T0: 1.8)	(T0: 2)	7.4 (T0: 4.7)	3.8 (T0: 2.8)	4.1	3.7	3.7 (T0: 2.4)	3.9 (T0: 3.1)	3.7 (T0: 2.3)	7.4 (T0: 4.7)	3.8 (T0: 2.8)	partial double copy

LBFIFU (n=11)	2.2 (T0: 2)	2.5	2.4 (T0: 2.2)	2.4 (T0: 2.1)	(T0: 1.7)	6.5 (T0: 4.2)	2.6 (T0: 1.9)	3.2	4.9	4.3 (T0: 2.3)	4.2	4 (T0: 2.6)	6.5 (T0: 4.2)	3.8 (T0: 3)	partial double copy
LBFDKD (n=2)	3.6 (T0: 1.6)	3.7	3.6 (T0: 2.1)	3.9 (T0: 2.2)	(T0: 1.8)	7.6 (T0: 3.4)	2.9 (T0: 2.1)	3.5	3.6	3.8 (T0: 1.9)	4.3 (T0: 2)	4.3 (T0: 1.8)	7.6 (T0: 3.4)	4 (T0: 1.6)	double copy
LBFDJG (n=12)	3.6 (T0: 1.6)	3.7	4 (T0: 1.8)	3.7 (T0: 1.6)	(T0: 1.9)	8 (T0: 3.6)	3.6 (T0: 2)	4	3.9	4.1 (T0: 1.9)	4.1 (T0: 2.2)	3.7 (T0: 1.9)	8 (T0: 3.6)	4.5 (T0: 1.9)	double copy
LBFLFK (n=15)	3.7 (T0: 2)	3.9	3.7 (T0: 2.4)	3.6 (T0: 2.3)	(T0: 2)	7.5 (T0: 5.2)	4.1 (T0: 2.2)	3.7	3.8	3.8 (T0: 1.3)	4.1 (T0: 2.4)	3.9 (T0: 1.8)	7.5 (T0: 5.2)	4 (T0: 2)	double copy
LBFLCG (n=15)	3.8 (T0: 1.9)	3.9	3.7 (T0: 2.3)	3.7 (T0: 1.9)	(T0: 1.7)	9 (T0: 5.1)	3.8 (T0: 1.9)	3.9	3.9	3.7 (T0: 2)	3.9 (T0: 2.5)	5.6 (T0: 2.2)	9 (T0: 5.1)	3.9 (T0: 2)	double copy
LBFPQM (n=12)	4 (T0: 2)	3.8	4.1 (T0: 1.8)	4.1 (T0: 2)	(T0: 1.5)	7.6 (T0: 3.7)	3.9 (T0: 2)	4	3.8	3.8 (T0: 1.8)	4 (T0: 2)	4.2 (T0: 1.5)	7.6 (T0: 3.7)	4.1 (T0: 1.8)	double copy
LBFDHG (n=5)	4.2 (T0: 1.9)	4	3.8 (T0: 2.3)	3.8 (T0: 1.8)	(T0: 1.6)	7.7 (T0: 3.3)	3.9 (T0: 1.9)	3.7	3.6	3.8 (T0: 2)	3.9 (T0: 2.3)	3.9 (T0: 1.7)	7.7 (T0: 3.3)	3.9 (T0: 1.9)	double copy
LBFCYO (n=0)	(T0: 3)		(T0: 2.2)	(T0: 2)	(T0: 2)	(T0: 3)	(T0: 3.4)			(T0: 2)	(T0: 2.1)	(T0: 1.8)	(T0: 3)	(T0: 0.6)	partial double copy
LBFBAJ (n=0)	(T0: 1)	(T0: 1.1)	(T0: 1.1)	(T0: 1)	(T0: 1.7)	(T0: 4.8)	(T0: 2)			(T0: 2)	(T0: 2.5)	(T0: 1.8)	(T0: 4.8)	(T0: 2)	partial double copy
LBFDJI (n=0)	(T0: 1.1)		(T0: 1.2)	(T0: 1)	(T0: 1)	(T0: 3)	(T0: 2)			(T0: 1.5)	(T0: 2.5)	(T0: 2.1)	(T0: 3)	(T0: 1.7)	partial double copy
LBFGGO (n=0)	(T0: 1)		(T0: 1)	(T0: 1.1)	(T0: 1)	(T0: 2.6)	(T0: 1)			(T0: 2.1)	(T0: 2.1)	(T0: 2)	(T0: 2.6)	(T0: 1.9)	partial double copy
LBFLFP (n=0)	(T0: 0.9)		(T0: 1.2)	(T0: 1.2)	(T0: 1.8)	(T0: 3.5)	(T0: 2)			(T0: 1.8)	(T0: 2.1)	(T0: 1.7)	(T0: 3.5)	(T0: 1.7)	partial double copy
LBFNQV (n=0)	(T0: 1.1)		(T0: 1.2)	(T0: 1)	(T0: 1)	(T0: 2.7)	(T0: 1.8)			(T0: 1.7)	(T0: 2.3)	(T0: 1.7)	(T0: 2.7)	(T0: 2)	partial double copy
LBFNLT (n=0)	(T0: 1.1)		(T0: 1.2)	(T0: 1)	(T0: 1.8)	(T0: 3.3)	(T0: 1.8)			(T0: 1.8)	(T0: 2.2)	(T0: 1.8)	(T0: 3.3)	(T0: 1.9)	partial double copy
LBFLGC (n=0)	(T0: 1)		(T0: 1.1)	(T0: 1.1)	(T0: 1)	(T0: 2.5)	(T0: 1.1)			(T0: 3)	(T0: 2.6)	(T0: 2.2)	(T0: 2.5)	(T0: 1.8)	partial double copy
LBFLCW (n=0)	(T0: 0.9)		(T0: 1.2)	(T0: 1)	(T0: 0.8)	(T0: 3.6)	(T0: 1.7)			(T0: 1.5)	(T0: 2)	(T0: 1.6)	(T0: 3.6)	(T0: 1.5)	partial double copy
LBFZPJ (n=0)	(T0: 2)		(T0: 1.8)	(T0: 1.9)	(T0: 1)	(T0: 3.5)	(T0: 1)			(T0: 2.3)	(T0: 3)	(T0: 2.4)	(T0: 3.5)	(T0: 2.4)	partial double copy
LBFNSS (n=0)	(T0: 1.1)		(T0: 1)	(T0: 1.2)	(T0: 1.1)	(T0: 2.5)	(T0: 1.8)			(T0: 2.3)	(T0: 2.5)	(T0: 2)	(T0: 2.5)	(T0: 2)	partial double copy
LBGAOR (n=0)	(T0: 1.1)		(T0: 1.8)	(T0: 2)	(T0: 1.7)	(T0: 2.9)	(T0: 1.8)			(T0: 1.8)	(T0: 1.1)	(T0: 1)	(T0: 2.9)	(T0: 1.1)	partial double copy
LBFZOE (n=0)	(T0: 1)		(T0: 1)	(T0: 1.1)	(T0: 1.1)	(T0: 2.8)	(T0: 1)			(T0: 1.1)	(T0: 2.1)	(T0: 1.7)	(T0: 2.8)	(T0: 1.8)	partial double copy

LBFDJS (n=0)	(T0: 1)		(T0: 1.2)	(T0: 1)	(T0: 1)	(T0: 2.9)	(T0: 1.2)			(T0: 0.9)	(T0: 2.2)	(T0: 1.9)	(T0: 2.9)	(T0: 1.9)	partial double copy
LBFDKC (n=0)	(T0: 1)		(T0: 1)	(T0: 1.2)	(T0: 1.8)	(T0: 2.5)	(T0: 2.2)			(T0: 1.7)	(T0: 1.6)	(T0: 1.4)	(T0: 2.5)	(T0: 0.6)	partial double copy
LBFDKA (n=5)	4.2 (T0: 1.6)	3.8	5.4 (T0: 2.6)	5.2 (T0: 3.1)	(T0: 2.4)	10.1 (T0: 5.6)	4.8 (T0: 3.1)	6	5.7	5.7 (T0: 3.3)	5.7 (T0: 3.9)	5.9 (T0: 2.9)	10.1 (T0: 5.6)	5.7 (T0: 3.5)	partial triple copy
LBFLGH (n=0)	(T0: 0.9)		(T0: 1)	(T0: 1.1)	(T0: 1.1)	(T0: 2.9)	(T0: 2.3)			(T0: 2.5)	(T0: 3)	(T0: 2.1)	(T0: 2.9)	(T0: 2.5)	partial triple copy
LBFNUS (n=0)	(T0: 1.1)		(T0: 1)	(T0: 0.9)	(T0: 1.4)	(T0: 3.9)	(T0: 2.2)			(T0: 2.3)	(T0: 3.1)	(T0: 2.3)	(T0: 3.9)	(T0: 3.3)	partial triple copy
LBFLCH (n=0)	(T0: 1.8)		(T0: 2.1)	(T0: 2.1)	(T0: 2.3)	(T0: 5)	(T0: 3.1)			(T0: 2.3)	(T0: 5.3)	(T0: 3.3)	(T0: 5)	(T0: 3.4)	partial triple copy
LBFZMI (n=0)	(T0: 3.3)		(T0: 2.1)	(T0: 2)	(T0: 1.5)	(T0: 4.6)	(T0: 2.2)			(T0: 1.7)	(T0: 1.9)	(T0: 2.9)	(T0: 4.6)	(T0: 2.6)	partial triple copy
LBFIDT (n=7)	3.8 (T0: 1.5)	4	4.3 (T0: 2.2)	4.2 (T0: 1.9)	(T0: 1.5)	8.5 (T0: 4.5)	4 (T0: 2.5)	4.3	4.3	4.3 (T0: 2.5)	3.8 (T0: 3.8)	4.2 (T0: 2.4)	8.5 (T0: 4.5)	3.9 (T0: 2.4)	partial triple copy
LBFAZW (n=0)	(T0: 1.8)	(T0: 2)	(T0: 2.1)	(T0: 1.8)	(T0: 1.4)	(T0: 4.5)	(T0: 1.7)			(T0: 2.5)	(T0: 3.3)	(T0: 2.4)	(T0: 4.5)	(T0: 2.5)	partial triple copy
LBFBBI (n=0)	(T0: 2)	(T0: 2)	(T0: 1.9)	(T0: 1.5)	(T0: 1.6)	(T0: 4.2)	(T0: 1.9)			(T0: 1.9)	(T0: 2.7)	(T0: 1.9)	(T0: 4.2)	(T0: 1.7)	partial triple copy
LBFAZW (n=0)	(T0: 1.8)	(T0: 2)	(T0: 2.1)	(T0: 1.8)	(T0: 1.4)	(T0: 4.5)	(T0: 1.7)			(T0: 2.5)	(T0: 3.3)	(T0: 2.4)	(T0: 4.5)	(T0: 2.5)	partial triple copy

Table 136: Expected Mendelian segregation of the genotype in T1 seeds for some possible T-DNA insertion scenarios. Listed are the expected copy number segregation ratios for T1 seeds segregating for one or more unlinked genomic loci, which contain one or more linked copies of T-DNA insertions. sc: single copy, dc: double copy

	Ratio of copy numbers (cn) expected T1 seed segregating for given locus configuration												
Locus configuration	cn=0	cn=1	cn=2	cn=3	cn=4	cn=5	cn=6	cn=7	cn=8	cn=9	cn=10	cn=11	cn=12
1 sc locus	1	2	1										
1 dc locus	1		2		1								
2 sc loci	1	4	6	4	1								
2 sc loci, 1 dc locus	1	2	3	4	3	2	1						
3 sc loci, 1 dc locus	1	4	8	12	14	12	8	4	1				

Table 137: Observed Medelian segregation of the genotype of T1 seeds of events from construct VC-LTM593-1qcz rc. The segregation has been analysed at three positions of the T-DNA. For each position, the number of seedlings have been counted that have a copy number (aritmetically rounded) of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. The of seedlings counted for each copy number category are separated by colon, displaying the categories in the following order: 0 : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12. Listed are the observed copy number segregation ratios for T1 seeds segregating for one or more unlinked genomic loci, which contain one or more linked copies of T-DNA insertions. The observed frequencies for each assay have been compared against expected frequencies for various locus configurations listed in Table 136 using Chi-Square analysis. The last column displays the total number of loci that are segregating in the genome of a given event. Many events contain truncated insertions, as was evident when some assays indicate single copy insertion at e.g. the left border (e.g. event LBFDAU, LPFPNC), while other positions on the T-DNA clearly indicate a double copy insertion that was either inserted in one locus (e.g. event LBFPNC), or in two loci (e.g. event LBFDAU)

Event	Copy number ratios measured near the left border of the T-DNA using assay A1	Copy number ratios measured using T-DNA internal assays targeting reagions that had copy number results indicating truncated T-DNA insertions using assay A06, or A08, or A09, or A10	Copy number ratios measured near the right border of the T-DNA using assay A12	Most likely number of loci containing one or more T-DNA copies, tested using Chi-Square test

LBFDGG	073 : 122 : 053 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 076 : 119 : 053 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	073 : 123 : 052 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFGKN	057 : 131 : 059 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 057 : 130 : 059 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	057 : 130 : 060 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFIHE	076 : 125 : 042 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 075 : 123 : 035 : 009 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	076 : 122 : 036 : 010 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFLDI	068 : 101 : 059 : 018 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 075 : 094 : 062 : 015 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	068 : 106 : 053 : 018 : 002 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFPNF	065 : 128 : 055 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 066 : 000 : 127 : 001 : 053 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000	064 : 001 : 127 : 001 : 051 : 002 : 002 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFNSQ	063 : 109 : 066 : 005 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 063 : 000 : 110 : 011 : 049 : 010 : 000 : 000 : 000 : 000 : 000 : 000 : 000	063 : 114 : 061 : 005 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFDGL	072 : 113 : 062 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 072 : 000 : 108 : 007 : 061 : 000 : 001 : 000 : 000 : 000 : 000 : 000 : 000	073 : 113 : 061 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFIEF	042 : 000 : 018 : 020 : 013 : 002 : 004 : 000 : 001 : 000 : 000 : 000 : 000	A12 : 042 : 000 : 025 : 015 : 012 : 005 : 000 : 001 : 000 : 000 : 000 : 000 : 000	041 : 032 : 020 : 005 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFBAV	068 : 128 : 053 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 068 : 000 : 128 : 000 : 053 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	068 : 000 : 000 : 122 : 006 : 000 : 044 : 009 : 000 : 000 : 000 : 000 : 000	one locus
LBFPNC	043 : 074 : 035 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 043 : 002 : 072 : 001 : 034 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	043 : 000 : 074 : 001 : 034 : 000 : 001 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFGHQ	067 : 000 : 113 : 007 : 051 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 065 : 110 : 057 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	066 : 104 : 059 : 003 : 003 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFAZB	078 : 001 : 158 : 002 : 055 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 078 : 001 : 151 : 008 : 055 : 002 : 001 : 000 : 000 : 000 : 000 : 000 : 000	078 : 161 : 054 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFGKW	047 : 000 : 124 : 007 : 070 : 000 : 001 : 000 : 000 : 000 : 000 : 000 : 000	A13 : 047 : 000 : 124 : 012 : 065 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	047 : 129 : 073 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFNRU	070 : 000 : 120 : 003 : 056 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A11 : 069 : 000 : 121 : 001 : 056 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	070 : 121 : 058 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus

LBFGIZ	073 : 000 : 108 : 001 : 045 : 004 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A11 : 073 : 000 : 108 : 002 : 044 : 004 : 000 : 000 : 000 : 000 : 000 : 000 : 000	072 : 109 : 048 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFIGM	055 : 000 : 133 : 004 : 056 : 000 : 001 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 054 : 000 : 133 : 004 : 056 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	055 : 137 : 057 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFNRR	070 : 000 : 116 : 004 : 057 : 000 : 000 : 000 : 001 : 000 : 000 : 000 : 000	A11 : 070 : 000 : 115 : 001 : 062 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	070 : 117 : 061 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFNTK	054 : 003 : 119 : 005 : 063 : 004 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 053 : 003 : 115 : 003 : 070 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000	053 : 122 : 072 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFGJA	088 : 000 : 111 : 006 : 041 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 088 : 002 : 111 : 003 : 041 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	089 : 001 : 113 : 003 : 039 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFIFV	070 : 000 : 119 : 000 : 056 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 070 : 119 : 057 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	070 : 000 : 119 : 000 : 056 : 001 : 001 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFLER	073 : 000 : 123 : 002 : 051 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A13 : 074 : 000 : 121 : 002 : 050 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	073 : 000 : 123 : 002 : 051 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFLDL	069 : 000 : 129 : 008 : 043 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A13 : 069 : 000 : 130 : 002 : 045 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	068 : 000 : 130 : 006 : 041 : 001 : 001 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFNQW	070 : 001 : 123 : 007 : 045 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A13 : 070 : 000 : 123 : 001 : 053 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	070 : 001 : 122 : 005 : 047 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000	one locus
LBFBAP	059 : 123 : 064 : 001 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 059 : 001 : 123 : 015 : 049 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	009 : 037 : 068 : 057 : 051 : 022 : 002 : 000 : 000 : 000 : 000 : 000 : 000	double locus, isolation of one locus
LBFDAU	059 : 123 : 062 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 013 : 069 : 090 : 062 : 010 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	013 : 072 : 087 : 062 : 010 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFPRA	024 : 075 : 087 : 057 : 005 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 024 : 041 : 060 : 058 : 052 : 012 : 001 : 000 : 000 : 000 : 000 : 000 : 000	024 : 041 : 060 : 051 : 049 : 022 : 001 : 000 : 000 : 000 : 000 : 000 : 000	double locus, isolation of one locus
LBFIFU	019 : 075 : 105 : 034 : 013 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A13 : 019 : 040 : 060 : 067 : 044 : 013 : 003 : 000 : 000 : 000 : 000 : 000 : 000	019 : 040 : 060 : 072 : 039 : 013 : 003 : 000 : 000 : 000 : 000 : 000 : 000	double locus, isolation of one locus

LBFDKD	007 : 031 : 045 : 018 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 007 : 031 : 046 : 017 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	007 : 031 : 044 : 017 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFDJG	026 : 078 : 088 : 036 : 014 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 029 : 072 : 085 : 035 : 017 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	026 : 076 : 077 : 037 : 022 : 004 : 001 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFLFK	018 : 062 : 096 : 058 : 015 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A11 : 018 : 061 : 096 : 059 : 015 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	018 : 061 : 098 : 057 : 015 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFLCG	015 : 059 : 087 : 068 : 015 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 016 : 058 : 087 : 067 : 016 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	016 : 056 : 090 : 065 : 015 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFPQM	008 : 058 : 094 : 060 : 014 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 008 : 058 : 094 : 062 : 012 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	008 : 058 : 095 : 061 : 012 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFDHG	022 : 064 : 084 : 037 : 004 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 023 : 062 : 090 : 033 : 005 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	023 : 063 : 089 : 034 : 005 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFCYO	091 : 001 : 002 : 013 : 090 : 001 : 006 : 031 : 001 : 000 : 000 : 000 : 000	A14 : 059 : 126 : 051 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	059 : 126 : 051 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFBAJ	056 : 140 : 048 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 017 : 056 : 093 : 064 : 014 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	016 : 056 : 091 : 032 : 043 : 005 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFDJI	151 : 285 : 171 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 051 : 073 : 118 : 157 : 149 : 036 : 023 : 002 : 001 : 000 : 000 : 000 : 000	049 : 152 : 228 : 129 : 041 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFGGO	017 : 034 : 030 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 009 : 011 : 030 : 023 : 008 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	009 : 011 : 031 : 023 : 007 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFLFP	047 : 094 : 053 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 046 : 092 : 056 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	010 : 038 : 069 : 049 : 027 : 001 : 001 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFNQV	174 : 289 : 138 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 174 : 286 : 138 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	049 : 163 : 210 : 126 : 048 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFNLT	149 : 279 : 145 : 010 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 015 : 067 : 130 : 063 : 033 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	029 : 146 : 214 : 136 : 055 : 007 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFLGC	064 : 121 : 057 : 005 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 013 : 034 : 059 : 060 : 049 : 026 : 006 : 000 : 002 : 000 : 000 : 000 : 000	013 : 068 : 112 : 048 : 008 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus

LBFLCW	207 : 283 : 098 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 065 : 152 : 224 : 131 : 018 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	064 : 156 : 232 : 110 : 022 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFZPJ	060 : 000 : 129 : 000 : 059 : 000 : 001 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 013 : 032 : 042 : 066 : 059 : 029 : 008 : 000 : 000 : 000 : 000 : 000 : 000	013 : 032 : 044 : 065 : 049 : 036 : 010 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFNSS	155 : 359 : 142 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 044 : 094 : 127 : 183 : 113 : 058 : 033 : 003 : 002 : 000 : 000 : 000 : 000	042 : 163 : 268 : 141 : 039 : 003 : 001 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBGAOR	149 : 302 : 144 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A04 : 040 : 158 : 274 : 103 : 019 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	161 : 310 : 120 : 003 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFZOE	026 : 060 : 035 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 010 : 025 : 051 : 026 : 008 : 002 : 000 : 000 : 000 : 000 : 000 : 000 : 000	010 : 025 : 049 : 031 : 006 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFDJS	048 : 131 : 060 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 008 : 043 : 090 : 074 : 026 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	008 : 043 : 089 : 075 : 025 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	double locus
LBFDKC	001 : 109 : 133 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A07 : 001 : 000 : 109 : 008 : 126 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	001 : 108 : 132 : 004 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	no wildtypes
LBFDKA	015 : 072 : 101 : 052 : 008 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 001 : 012 : 041 : 054 : 076 : 045 : 018 : 001 : 000 : 000 : 000 : 000 : 000	001 : 012 : 041 : 053 : 069 : 050 : 019 : 003 : 000 : 000 : 000 : 000 : 000	triple locus
LBFLGH	061 : 137 : 051 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 015 : 034 : 052 : 068 : 039 : 026 : 012 : 002 : 001 : 000 : 000 : 000 : 000	014 : 033 : 053 : 060 : 045 : 030 : 012 : 001 : 000 : 000 : 000 : 000 : 000	triple locus
LBFNUS	054 : 137 : 058 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 003 : 016 : 048 : 054 : 034 : 008 : 003 : 000 : 000 : 000 : 000 : 000 : 000	004 : 020 : 071 : 081 : 060 : 010 : 003 : 000 : 000 : 000 : 000 : 000 : 000	triple locus
LBFLCH	019 : 077 : 090 : 052 : 011 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 019 : 039 : 013 : 006 : 050 : 050 : 021 : 008 : 019 : 013 : 009 : 002 : 000	019 : 039 : 013 : 041 : 063 : 027 : 026 : 013 : 007 : 000 : 000 : 000 : 000	triple locus
LBFZMI	017 : 016 : 036 : 038 : 023 : 027 : 005 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 017 : 043 : 061 : 033 : 008 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	007 : 015 : 039 : 051 : 034 : 014 : 002 : 000 : 000 : 000 : 000 : 000 : 000	triple locus
LBFIDT	069 : 000 : 131 : 000 : 045 : 001 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 015 : 033 : 058 : 064 : 048 : 015 : 012 : 002 : 000 : 000 : 000 : 000 : 000	003 : 018 : 050 : 056 : 061 : 031 : 019 : 008 : 000 : 000 : 000 : 000 : 000	triple locus, isolation of one locus
LBFAZW	013 : 065 : 109 : 041 : 006 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 004 : 021 : 073 : 086 : 040 : 010 : 001 : 000 : 000 : 000 : 000 : 000 : 000	003 : 018 : 069 : 079 : 048 : 013 : 002 : 000 : 001 : 000 : 000 : 000 : 000	trippel locus

LBFBBI	005 : 057 : 139 : 040 : 004 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 009 : 030 : 074 : 066 : 051 : 014 : 001 : 000 : 000 : 000 : 000 : 000 : 000	005 : 065 : 127 : 044 : 004 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	trippel locus
LBFAZW	013 : 065 : 109 : 041 : 006 : 000 : 000 : 000 : 000 : 000 : 000 : 000 : 000	A12 : 004 : 021 : 073 : 086 : 040 : 010 : 001 : 000 : 000 : 000 : 000 : 000 : 000	003 : 018 : 069 : 079 : 048 : 013 : 002 : 000 : 001 : 000 : 000 : 000 : 000	trippel locus

Table 138: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T2 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDGG (n=50)	4.8 ± 0.2	0.2 ± 0	0 ± 0	2.9 ± 0.3	28.3 ± 1.5	35.6 ± 1	0.8 ± 0.1	4.5 ± 0.3	1.9 ± 0.2	0.4 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	2.7 ± 0.2	1.5 ± 0.1	2.2 ± 0.3	7.7 ± 0.8	0.4 ± 0	0 ± 0	0.3 ± 0.1	1.9 ± 0.2	0.2 ± 0	1.4 ± 0.3	0.3 ± 0.1	0.2 ± 0.1
LBFGKN (n=50)	4.6 ± 0.3	0.1 ± 0	0 ± 0	3 ± 0.2	28.3 ± 1.6	35.2 ± 0.7	1 ± 0.1	4.6 ± 0.3	2 ± 0.3	0.5 ± 0.2	0.8 ± 0	0.7 ± 0	0.2 ± 0	0.1 ± 0	2.8 ± 0.2	1.4 ± 0.1	2.3 ± 0.2	8.1 ± 0.9	0.4 ± 0	0 ± 0	0.3 ± 0	1.9 ± 0.2	0 ± 0	1.4 ± 0.3	0.2 ± 0	0.2 ± 0
LBFIHE (n=34)	5.4 ± 0.9	0.2 ± 0.1	0 ± 0	3.1 ± 0.4	26.6 ± 2.1	34.7 ± 1.4	0.9 ± 0.2	3.9 ± 0.4	2.6 ± 0.9	0.3 ± 0.1	1 ± 0.1	0.9 ± 0.1	0.2 ± 0.1	0.1 ± 0	3.1 ± 0.3	1.5 ± 0.2	2.5 ± 0.4	8.4 ± 1	0.4 ± 0	0 ± 0	0.3 ± 0.1	1.6 ± 0.2	0.1 ± 0	1.5 ± 0.3	0.2 ± 0.1	0.3 ± 0.1
LBFLDI (n=60)	6.6 ± 1.2	0.3 ± 0.1	0 ± 0	2.2 ± 0.2	31.1 ± 3.3	30 ± 1.9	0.7 ± 0.2	6 ± 0.6	1.1 ± 0.3	0.2 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.4 ± 0.3	0.2 ± 0.1	2.6 ± 0.2	1.6 ± 0.2	1.7 ± 0.2	8.2 ± 1.7	0.4 ± 0	0 ± 0	0.3 ± 0.1	2.4 ± 0.5	0.1 ± 0	1.4 ± 0.3	0.3 ± 0	0.4 ± 0.1
LBFPNF (n=52)	5 ± 0.2	0.2 ± 0	0 ± 0	2.5 ± 0.2	30.5 ± 1.3	27.8 ± 1.1	1.8 ± 0.2	4.5 ± 0.4	2.9 ± 0.3	0.4 ± 0.1	0.8 ± 0.1	0.7 ± 0.1	0.1 ± 0	0 ± 0	3.5 ± 0.3	1.5 ± 0.4	2.5 ± 0.2	9.8 ± 0.8	0.4 ± 0	0 ± 0	0.3 ± 0	2.7 ± 0.3	0.1 ± 0	1.2 ± 0.1	0.3 ± 0	0.2 ± 0.1
LBFNSQ (n=51)	5 ± 0.4	0.1 ± 0	0 ± 0	2.7 ± 0.5	26.9 ± 1.6	35.7 ± 1.9	0.8 ± 0.2	5.4 ± 0.6	1.5 ± 0.2	0.3 ± 0.1	0.8 ± 0.1	0.4 ± 0.4	0.2 ± 0.1	0.1 ± 0	4.3 ± 0.6	2.2 ± 0.3	1.6 ± 0.4	6.8 ± 1.4	0.4 ± 0	0 ± 0	0.4 ± 0	1.7 ± 0.3	0.1 ± 0	1.3 ± 0.3	0.6 ± 0.2	0.5 ± 0.3
LBFDGL (n=57)	4.9 ± 0.1	0.1 ± 0	0 ± 0	3 ± 0.4	26.9 ± 2.2	36.3 ± 1.9	0.6 ± 0.2	5.8 ± 0.7	1.5 ± 0.8	0.3 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.2 ± 0	0.1 ± 0	4.7 ± 0.7	3 ± 0.5	0.8 ± 0.3	5.5 ± 1.8	0.4 ± 0	0 ± 0	0.3 ± 0.1	1.4 ± 0.3	0.1 ± 0	1 ± 0.4	0.9 ± 0.3	0.2 ± 0.1
LBFIEF (n=6)	5 ± 0.2	0.1 ± 0	0 ± 0	3.4 ± 0.4	27.6 ± 2.9	36.2 ± 2.1	0.6 ± 0.1	5.7 ± 0.5	1.5 ± 0.2	0.4 ± 0.2	1 ± 0.1	0.7 ± 0	0.2 ± 0	0.1 ± 0.1	4.2 ± 0.3	2.5 ± 0.3	0.7 ± 0.3	5.2 ± 0.8	0.4 ± 0	0 ± 0	0.4 ± 0.1	1.6 ± 0.3	0.1 ± 0	1 ± 0.3	0.9 ± 0.2	0.2 ± 0
LBFBAV (n=50)	5.1 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.3	29.5 ± 1.3	27.2 ± 1.4	1.6 ± 0.2	5.3 ± 0.3	1.6 ± 0.1	0.3 ± 0	0.8 ± 0.2	0.7 ± 0	0.1 ± 0	0.1 ± 0.1	10.9 ± 0.7	6.5 ± 0.5	0.1 ± 0.1	1.8 ± 0.7	0.4 ± 0	0 ± 0	0.1 ± 0.1	0.8 ± 0.3	0.1 ± 0.1	0.3 ± 0.1	3 ± 0.5	0.7 ± 0.1
LBFPNC (n=32)	4.8 ± 0.3	0.1 ± 0	0 ± 0	3.9 ± 0.7	26.7 ± 1.7	35.6 ± 1	0.8 ± 0.1	3.3 ± 0.5	1.7 ± 0.3	0.2 ± 0.1	1.1 ± 0.2	0.7 ± 0	0.2 ± 0	0 ± 0	4.9 ± 0.9	2 ± 0.4	2.4 ± 0.7	6.9 ± 1.6	0.4 ± 0.1	0 ± 0	0.3 ± 0.1	1.9 ± 0.5	0.1 ± 0	0.9 ± 0.2	0.4 ± 0.2	0.4 ± 0.1
LBFGHQ (n=46)	5.1 ± 0.2	0.1 ± 0.1	0 ± 0	2.4 ± 0.1	30.7 ± 1.3	35 ± 1.7	0.5 ± 0.1	7.7 ± 0.6	1.3 ± 0.2	0.4 ± 0.1	0.9 ± 0.3	0.8 ± 0.1	0.1 ± 0	0.1 ± 0	2.5 ± 0.3	1.7 ± 0.2	0.6 ± 0.1	4.9 ± 0.7	0.4 ± 0	0 ± 0	0.3 ± 0	1.9 ± 0.3	0.2 ± 0	1 ± 0.2	0.8 ± 0.1	0.3 ± 0.1
LBFAZB (n=49)	4.9 ± 0.1	0.1 ± 0	0 ± 0	3.1 ± 0.2	28.4 ± 1.6	34.1 ± 1.1	1 ± 0.1	4.7 ± 0.4	1.9 ± 0.3	0.3 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.1 ± 0.1	0.1 ± 0	6.3 ± 0.7	3.3 ± 0.3	0.8 ± 0.2	4.5 ± 0.9	0.3 ± 0	0 ± 0	0.4 ± 0	1.4 ± 0.2	0.1 ± 0	0.9 ± 0.2	1.5 ± 0.3	0.2 ± 0

LBFGKW (n=72)	5.1 ± 0.2	0.2 ± 0	0 ± 0	2.5 ± 0.2	30.1 ± 1.3	32.1 ± 1.6	1.1 ± 0.1	6.1 ± 0.4	1.7 ± 0.3	0.2 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	6 ± 0.7	3.3 ± 0.4	0.5 ± 0.1	4.1 ± 0.8	0.4 ± 0	0 ± 0	0.4 ± 0.1	1.5 ± 0.3	0.1 ± 0	0.8 ± 0.2	1.7 ± 0.3	0.3 ± 0.1
LBFNRU (n=58)	5 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.2	31.8 ± 2.5	29.2 ± 1.9	1 ± 0.1	7.1 ± 0.5	1.2 ± 0.2	0.2 ± 0	0.8 ± 0.1	0.8 ± 0	0.1 ± 0	0.1 ± 0	5.9 ± 0.7	3.6 ± 0.5	0.4 ± 0.1	4.2 ± 0.9	0.4 ± 0	0 ± 0	0.4 ± 0	1.7 ± 0.4	0.1 ± 0	0.9 ± 0.3	1.9 ± 0.4	0.3 ± 0.1
LBFGIZ (n=43)	4.9 ± 0.6	0.2 ± 0.1	0 ± 0	2.6 ± 0.4	30.5 ± 3	30 ± 2.6	1 ± 0.2	6.2 ± 0.8	1.3 ± 0.2	0.2 ± 0	0.8 ± 0.1	0.7 ± 0.1	0.2 ± 0	0.2 ± 0	5.7 ± 0.8	3.5 ± 0.5	0.6 ± 0.1	5.3 ± 1.1	0.4 ± 0	0 ± 0	0.4 ± 0.1	2.1 ± 0.4	0.1 ± 0	1 ± 0.2	1.7 ± 0.4	0.4 ± 0.1
LBFIGM (n=56)	4.8 ± 0.4	0.2 ± 0	0 ± 0	2.3 ± 0.2	31.9 ± 2.7	30.6 ± 2.7	1 ± 0.1	6.3 ± 0.7	1.3 ± 0.2	0.2 ± 0	0.7 ± 0.1	0.8 ± 0.1	0.1 ± 0	0.1 ± 0	5 ± 0.7	2.5 ± 0.3	1 ± 0.2	5.4 ± 1	0.4 ± 0	0 ± 0	0.4 ± 0.1	2 ± 0.5	0.4 ± 2.2	1 ± 0.2	1.2 ± 0.2	0.3 ± 0.1
LBFNRR (n=61)	5 ± 0.2	0.2 ± 0	0 ± 0	2.8 ± 0.4	31.4 ± 1.5	30 ± 2.1	1.1 ± 0.1	7 ± 0.6	1.3 ± 0.2	0.3 ± 0	0.9 ± 0.1	0.8 ± 0.1	0.1 ± 0	0.1 ± 0	5.3 ± 1.2	3.5 ± 0.3	0.4 ± 0.1	4.4 ± 1.1	0.4 ± 0	0 ± 0	0.3 ± 0	1.7 ± 0.4	0 ± 0	0.8 ± 0.2	1.7 ± 0.3	0.3 ± 0.1
LBFNTK (n=69)	5.1 ± 0.4	0.2 ± 0	0 ± 0	2.5 ± 0.2	29.6 ± 1.4	29 ± 1.8	1.3 ± 0.2	6.4 ± 0.6	1.5 ± 0.3	0.1 ± 0.1	0.8 ± 0.1	0.8 ± 0	0.1 ± 0	0.1 ± 0	6.7 ± 0.8	3.8 ± 0.5	0.6 ± 0.2	5 ± 0.9	0.4 ± 0	0 ± 0	0.5 ± 0.1	2 ± 0.4	0.1 ± 0	0.9 ± 0.2	1.8 ± 0.3	0.5 ± 0.1
LBFGJA (n=42)	5.2 ± 0.2	0.2 ± 0	0 ± 0	3.1 ± 0.2	27.7 ± 0.8	34.5 ± 0.8	1.9 ± 0.2	3.3 ± 0.2	5.8 ± 0.9	0.5 ± 0.2	0.8 ± 0	0.7 ± 0.1	0.1 ± 0	0.1 ± 0	4.7 ± 0.6	1.5 ± 0.2	1.3 ± 0.2	3.8 ± 0.6	0.3 ± 0	0 ± 0	0.7 ± 0.1	1.4 ± 0.2	0.1 ± 0	0.8 ± 0.2	1.2 ± 0.2	0.1 ± 0
LBFIFV (n=58)	4.8 ± 0.4	0.1 ± 0	0 ± 0	3.2 ± 0.3	27.6 ± 1.5	37.3 ± 0.9	0.8 ± 0.1	3.7 ± 0.2	1.8 ± 0.3	0.2 ± 0	0.9 ± 0.1	0.7 ± 0.2	0.1 ± 0	0.1 ± 0	6.3 ± 0.6	2.5 ± 0.2	1.3 ± 0.2	4.2 ± 0.7	0.4 ± 0	0 ± 0	0.4 ± 0.1	1.1 ± 0.2	0.1 ± 0	1.1 ± 0.3	1 ± 0.2	0.2 ± 0
LBFLER (n=52)	4.7 ± 0.1	0.1 ± 0	0 ± 0	3.1 ± 0.2	28.7 ± 2	33.9 ± 1.1	1 ± 0.1	4.4 ± 0.3	1.9 ± 0.5	0.3 ± 0	0.9 ± 0	0.7 ± 0	0.1 ± 0	0.1 ± 0	5.9 ± 0.6	2.9 ± 0.3	1.1 ± 0.2	5.3 ± 0.7	0.4 ± 0	0 ± 0	0.5 ± 0.1	1.7 ± 0.2	0 ± 0	1 ± 0.2	1.1 ± 0.2	0.2 ± 0.1
LBFLDL (n=44)	4.8 ± 0.1	0.1 ± 0	0 ± 0	3.4 ± 0.3	28 ± 1	34.6 ± 1	1 ± 0.1	4.2 ± 0.2	2.2 ± 0.5	0.3 ± 0	0.9 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	5.2 ± 0.6	2.5 ± 0.4	1.2 ± 0.3	5.5 ± 0.7	0.4 ± 0	0 ± 0	0.6 ± 0.1	1.9 ± 0.2	0.1 ± 0	0.8 ± 0.2	1 ± 0.2	0.2 ± 0
LBFNQW (n=51)	4.8 ± 0.2	0.1 ± 0	0 ± 0	3.2 ± 0.3	27.6 ± 1.5	33.5 ± 1.1	1 ± 0.1	4.2 ± 0.3	2 ± 0.3	0.3 ± 0	1.3 ± 0.3	0.9 ± 0.1	0.2 ± 0.1	0.1 ± 0.1	5.3 ± 0.5	2.7 ± 0.4	1.1 ± 0.2	6.2 ± 1	0.4 ± 0	0 ± 0	0.5 ± 0.1	2 ± 0.3	0.1 ± 0	0.9 ± 0.2	0.8 ± 0.4	0.5 ± 0.1
LBFBAP (n=19)	4.8 ± 0.1	0.1 ± 0	0 ± 0	3 ± 0.2	26 ± 0.9	33.8 ± 1	1.2 ± 0.1	3.4 ± 0.2	2.4 ± 0.3	0.3 ± 0	0.8 ± 0	0.7 ± 0	0.2 ± 0	0.1 ± 0	7.4 ± 0.7	2.9 ± 0.3	2.1 ± 0.3	6.2 ± 0.8	0.3 ± 0	0 ± 0	0.3 ± 0	1.7 ± 0.2	0.1 ± 0	1.1 ± 0.1	0.6 ± 0.1	0.4 ± 0.1
LBFDAU (n=10)	5.2 ± 1	0.2 ± 0	0 ± 0	3.3 ± 0.3	20.5 ± 0.9	31.8 ± 0.5	0.9 ± 0.1	4.1 ± 0.2	2.5 ± 0.2	0.3 ± 0	0.9 ± 0.1	0.6 ± 0.1	0.2 ± 0	0.1 ± 0	4.2 ± 0.2	3.1 ± 0.3	1.6 ± 0.3	13.9 ± 1	0.4 ± 0	0 ± 0	0.2 ± 0	2.3 ± 0.2	0.1 ± 0	2.6 ± 0.4	0.4 ± 0.1	0.3 ± 0
LBFPRA (n=16)	4.9 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.6	25.4 ± 2.2	31 ± 1.3	1.3 ± 0.2	5.4 ± 0.8	2 ± 0.4	0.2 ± 0.1	0.8 ± 0.1	0.8 ± 0	0.1 ± 0	0.1 ± 0	2.9 ± 0.6	1.6 ± 0.3	3 ± 0.3	12.3 ± 1.4	0.4 ± 0	0 ± 0	0.2 ± 0	2.7 ± 0.2	0 ± 0	1.4 ± 0.2	0.1 ± 0	0.4 ± 0.1
LBFIFU (n=11)	4.7 ± 0.2	0.1 ± 0	0 ± 0	3.8 ± 0.9	25.9 ± 2.6	34.7 ± 1.3	1.1 ± 0.3	3.6 ± 0.6	2.7 ± 0.9	0.3 ± 0.1	0.9 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	4.2 ± 0.6	1.7 ± 0.3	2.7 ± 0.5	8 ± 1.8	0.3 ± 0	0 ± 0	0.4 ± 0.1	2 ± 0.3	0.1 ± 0.1	1.3 ± 0.4	0.3 ± 0.2	0.2 ± 0
LBFDKD (n=2)	5.1 ± 0.2	0.2 ± 0	0 ± 0	3 ± 0.9	26.1 ± 3.9	35.6 ± 0.6	0.6 ± 0	4.8 ± 0.7	1.3 ± 0.4	0.2 ± 0.1	0.9 ± 0.2	0.8 ± 0	0.3 ± 0	0.2 ± 0	5.1 ± 1.6	3 ± 1.3	0.9 ± 0.4	5.7 ± 0.7	0.4 ± 0	0 ± 0	0.5 ± 0.1	2.2 ± 0.5	0.1 ± 0	1.1 ± 0.2	1.4 ± 0.7	0.3 ± 0
LBFDJG (n=12)	4.4 ± 0.1	0.1 ± 0	0 ± 0	3.4 ± 0.3	27.3 ± 1.4	33.1 ± 1.9	1.1 ± 0.2	3.6 ± 0.1	2.1 ± 0.4	0.4 ± 0.1	0.9 ± 0.1	0.6 ± 0.2	0.1 ± 0	0 ± 0	6.1 ± 1.1	2.6 ± 0.4	1.6 ± 0.4	6.8 ± 1.4	0.4 ± 0	0 ± 0	0.4 ± 0.1	1.7 ± 0.2	0.1 ± 0	1.3 ± 0.4	1 ± 0.4	0.4 ± 0.1
LBFLFK (n=15)	5.1 ± 0.3	0.2 ± 0	0 ± 0	2.5 ± 0.1	28.7 ± 1.6	29 ± 1.7	1.2 ± 0.2	5.6 ± 0.4	1.5 ± 0.2	0.2 ± 0	0.8 ± 0	0.7 ± 0	0.1 ± 0	0.1 ± 0	3.8 ± 0.3	2.4 ± 0.1	1.3 ± 0.1	9.9 ± 0.8	0.4 ± 0.1	0 ± 0	0.5 ± 0	3 ± 0.3	0.1 ± 0	1.8 ± 0.2	0.6 ± 0.1	0.3 ± 0.1
LBFLCG (n=15)	4.9 ± 0.3	0.1 ± 0	0 ± 0	3.6 ± 0.3	25.8 ± 1.4	34.1 ± 0.8	0.9 ± 0.1	4.4 ± 0.2	1.9 ± 0.2	0.3 ± 0	0.9 ± 0	0.6 ± 0	0.1 ± 0	0.1 ± 0	3.7 ± 0.5	2.2 ± 0.3	1.4 ± 0.2	9 ± 0.7	0.3 ± 0	0 ± 0	0.4 ± 0.1	2.5 ± 0.2	0.1 ± 0	1.6 ± 0.3	0.6 ± 0.2	0.2 ± 0
LBFPQM (n=12)	5.2 ± 0.3	0.1 ± 0	0 ± 0	3.8 ± 0.4	26.3 ± 1.2	31.6 ± 1	1.2 ± 0.1	4.3 ± 0.4	1.8 ± 0.2	0.2 ± 0	1.1 ± 0.1	0.9 ± 0.1	0.2 ± 0.1	0.2 ± 0	4.8 ± 0.6	3 ± 0.4	1.1 ± 0.2	8.2 ± 1.1	0.4 ± 0	0 ± 0	0.4 ± 0.1	2.2 ± 0.2	0.1 ± 0	1.5 ± 0.2	0.8 ± 0.1	0.5 ± 0.2

LBFDHG (n=5)	5.4 ± 0.1	0.2 ± 0	0 ± 0	2.3 ± 0.2	24 ± 0.6	34 ± 0.7	1 ± 0.1	4.1 ± 0.2	2.7 ± 0.1	0.3 ± 0	0.7 ± 0	0.7 ± 0	0.1 ± 0	0.1 ± 0	3 ± 0.1	1.7 ± 0.1	1.7 ± 0.1	10.4 ± 0.8	0.4 ± 0	0 ± 0	0.6 ± 0.1	2.4 ± 0.1	0.3 ± 0	2.7 ± 0.2	0.5 ± 0	0.2 ± 0
LBFDKA (n=5)	5.1 ± 0.3	0.1 ± 0	0 ± 0	3.7 ± 0.4	24.2 ± 2.8	29.7 ± 1.1	1.5 ± 0.3	4.4 ± 0.3	1.8 ± 0.1	0.2 ± 0	1.1 ± 0.1	0.9 ± 0.1	0.2 ± 0.1	0.2 ± 0	7.6 ± 0.6	5.1 ± 0.8	0.6 ± 0.1	6.6 ± 1	0.4 ± 0	0 ± 0	0.3 ± 0.1	2 ± 0.3	0.1 ± 0	1.3 ± 0.5	1.8 ± 0.2	0.9 ± 0
LBFIDT (n=7)	5 ± 0.1	0.2 ± 0	0 ± 0	2.6 ± 0.1	27 ± 1.7	30.8 ± 1.2	1.1 ± 0.2	6.2 ± 0.4	1.8 ± 0.2	0.4 ± 0.1	0.8 ± 0	0.7 ± 0	0.1 ± 0	0.1 ± 0	4.5 ± 1.3	3 ± 0.9	1 ± 0.2	8.2 ± 0.6	0.4 ± 0	0 ± 0	0.5 ± 0.1	2.6 ± 0.2	0.1 ± 0	1.7 ± 0.2	1 ± 0.3	0.3 ± 0.1

Table 139: Fatty acid profiles of one T2 seed batch per event harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T2 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDGG (n=1)	4.6	0.2	0.0	2.6	26.6	34.2	0.8	4.6	2.0	0.3	0.8	0.7	0.1	0.1	2.7	1.6	2.8	9.7	0.4	0.0	0.3	2.2	0.2	1.9	0.2	0.3
LBFGKN (n=1)	4.7	0.2	0.0	3.0	25.0	34.6	0.8	4.3	2.2	0.3	0.8	0.7	0.2	0.1	3.1	1.7	2.5	10.4	0.3	0.0	0.4	2.4	0.1	2.0	0.2	0.2
LBFIHE (n=1)	4.8	0.1	0.0	3.0	23.7	34.1	0.9	3.6	4.0	0.4	1.0	0.9	0.2	0.1	3.1	1.3	3.3	10.3	0.4	0.0	0.3	1.9	0.1	1.8	0.2	0.3
LBFLDI (n=1)	6.4	0.1	0.0	2.1	28.5	28.4	0.9	5.9	1.2	0.2	0.7	0.7	0.3	0.2	3.0	1.9	1.7	10.8	0.3	0.0	0.4	3.3	0.2	1.7	0.4	0.4
LBFPNF (n=1)	5.4	0.2	0.0	2.3	26.9	28.9	1.3	5.1	3.0	0.4	0.8	0.7	0.1	0.0	3.3	1.6	2.8	11.0	0.4	0.0	0.2	3.2	0.1	1.7	0.3	0.2
LBFNSQ (n=1)	4.7	0.1	0.0	2.4	23.6	34.2	1.0	4.7	2.2	0.4	0.7	0.0	0.3	0.1	4.3	2.3	2.3	10.2	0.4	0.0	0.5	2.2	0.1	2.0	0.4	0.7
LBFDGL (n=1)	4.9	0.1	0.0	2.5	23.9	32.2	1.0	6.0	1.7	0.3	0.7	0.7	0.1	0.1	4.6	2.9	1.4	10.1	0.4	0.0	0.3	2.0	0.2	2.2	1.0	0.3
LBFIEF (n=1)	4.7	0.1	0.0	3.0	27.0	37.2	0.6	5.1	1.4	0.2	1.0	0.7	0.2	0.3	4.3	2.6	0.9	5.9	0.4	0.0	0.5	1.4	0.1	1.2	0.7	0.2
LBFBAV (n=1)	5.9	0.2	0.0	2.5	23.9	27.6	1.0	5.7	1.8	0.3	0.9	0.7	0.1	0.3	10.2	7.6	0.3	4.2	0.5	0.0	0.0	2.0	0.0	1.1	2.6	0.4
LBFPNC (n=1)	4.7	0.1	0.0	2.3	19.8	35.1	0.6	3.9	2.7	0.3	0.6	0.7	0.2	0.1	4.3	1.8	4.6	11.4	0.3	0.0	0.6	3.9	0.1	1.1	0.4	0.3
LBFGHQ (n=1)	5.4	0.2	0.0	2.3	28.7	31.5	0.5	9.0	1.4	0.6	0.9	0.8	0.1	0.1	2.6	2.1	0.6	6.5	0.4	0.0	0.3	2.8	0.2	1.6	0.9	0.4
LBFAZB (n=1)	5.1	0.1	0.0	3.1	26.6	30.1	1.6	4.7	2.5	0.4	0.8	0.6	0.0	0.1	5.4	2.9	1.6	8.7	0.4	0.0	0.4	2.2	0.1	1.5	0.9	0.3
LBFGKW (n=1)	4.4	0.2	0.0	2.0	26.5	31.5	1.2	6.8	1.9	0.3	0.6	0.7	0.1	0.1	6.7	4.1	0.5	5.9	0.3	0.0	0.4	2.0	0.2	1.2	2.0	0.3
LBFNRU (n=1)	5.0	0.2	0.0	2.5	27.2	26.6	0.9	8.0	1.4	0.3	0.8	0.7	0.1	0.2	6.0	4.6	0.4	7.0	0.4	0.0	0.4	3.0	0.1	1.8	1.9	0.3
LBFGIZ (n=1)	5.2	0.2	0.0	2.3	27.3	31.2	0.7	6.1	1.5	0.2	0.7	0.4	0.2	0.2	5.3	3.1	1.0	7.4	0.4	0.0	0.5	2.8	0.1	1.4	1.4	0.5
LBFIGM (n=1)	4.9	0.1	0.0	2.5	28.9	29.6	1.6	5.8	1.8	0.3	0.8	0.8	0.1	0.1	5.0	2.5	1.5	7.9	0.4	0.0	0.4	2.2	0.1	1.5	0.9	0.4
LBFNRR (n=1)	4.8	0.1	0.0	2.8	27.3	26.9	1.9	6.5	1.9	0.3	0.9	0.8	0.1	0.1	5.4	3.7	0.8	8.9	0.4	0.0	0.3	2.5	0.1	1.6	1.1	0.5
LBFNTK (n=1)	4.9	0.2	0.0	2.4	29.0	27.5	1.1	6.8	1.4	0.2	0.7	0.7	0.2	0.1	5.9	3.6	1.0	7.3	0.4	0.0	0.6	3.0	0.1	1.1	1.5	0.4
LBFGJA (n=1)	5.2	0.2	0.0	3.0	27.1	33.5	2.1	3.4	5.2	0.6	0.8	0.7	0.1	0.1	4.2	1.6	1.5	5.4	0.3	0.0	0.7	1.6	0.2	1.2	1.0	0.2
LBFIFV (n=1)	4.8	0.1	0.0	3.4	21.6	34.4	0.8	3.5	2.8	0.3	0.9	0.7	0.2	0.1	6.8	2.9	2.2	7.6	0.4	0.0	0.6	1.8	0.3	2.6	1.0	0.2
LBFLER (n=1)	5.1	0.2	0.0	2.8	22.8	32.5	1.1	3.7	4.1	0.5	0.8	0.7	0.1	0.1	6.4	3.2	1.7	7.9	0.3	0.0	0.7	2.1	0.1	1.9	1.1	0.2
LBFLDL (n=1)	4.7	0.1	0.0	3.4	26.9	33.7	1.0	4.4	1.8	0.2	0.9	0.7	0.1	0.1	4.6	2.6	1.2	7.8	0.4	0.0	0.6	2.4	0.1	1.3	0.8	0.3

LBFNQW (n=1)	4.8	0.1	0.0	2.7	24.8	33.0	1.1	4.3	2.0	0.3	1.6	0.9	0.2	0.1	5.1	3.0	1.3	8.6	0.3	0.0	0.5	2.5	0.1	1.4	0.9	0.4
LBFBAP (n=1)	4.9	0.1	0.0	3.2	24.5	31.9	1.4	3.2	2.7	0.3	0.8	0.7	0.2	0.1	7.6	3.1	2.5	7.6	0.3	0.0	0.3	1.9	0.0	1.3	0.7	0.4
LBFDAU (n=1)	4.6	0.2	0.0	3.4	18.7	31.8	0.9	4.1	2.9	0.4	0.8	0.7	0.2	0.1	4.2	3.4	1.5	15.1	0.3	0.0	0.2	2.5	0.1	3.0	0.4	0.3
LBFPRA (n=1)	4.8	0.1	0.0	3.2	21.9	28.7	1.8	4.4	2.7	0.3	0.9	0.8	0.1	0.1	3.6	2.0	3.4	15.6	0.4	0.0	0.2	2.5	0.0	1.8	0.1	0.5
LBFIFU (n=1)	4.8	0.1	0.0	3.2	22.4	34.7	0.9	4.5	2.5	0.3	0.7	0.6	0.2	0.1	4.2	2.3	2.1	9.6	0.2	0.0	0.5	2.5	0.2	2.3	0.6	0.2
LBFDKD (n=1)	5.0	0.2	0.0	2.4	28.9	35.2	0.6	5.3	1.0	0.1	0.7	0.8	0.3	0.2	4.0	2.1	1.2	6.2	0.4	0.0	0.6	2.5	0.1	1.0	0.9	0.3
LBFDJG (n=1)	4.4	0.1	0.0	3.3	25.4	32.3	1.2	3.5	2.3	0.5	0.9	0.7	0.1	0.1	5.5	2.6	2.1	9.0	0.4	0.0	0.4	1.8	0.1	1.9	0.6	0.4
LBFLFK (n=1)	5.2	0.2	0.0	2.5	26.2	29.0	1.2	5.9	1.7	0.3	0.8	0.7	0.1	0.1	3.4	2.4	1.3	11.4	0.4	0.0	0.5	3.4	0.1	2.3	0.6	0.3
LBFLCG (n=1)	5.0	0.2	0.0	4.4	22.6	34.7	0.7	4.1	2.1	0.3	1.1	0.6	0.1	0.1	3.4	2.1	1.6	10.1	0.4	0.0	0.5	2.6	0.1	2.3	0.6	0.2
LBFPQM (n=1)	5.1	0.2	0.0	3.3	25.7	30.4	1.4	4.4	1.9	0.3	1.0	0.9	0.2	0.2	4.3	2.5	1.8	10.2	0.4	0.0	0.4	2.6	0.1	1.8	0.6	0.5
LBFDHG (n=1)	5.4	0.2	0.0	2.1	23.9	33.5	1.1	4.0	2.6	0.3	0.7	0.7	0.1	0.1	3.0	1.8	1.7	11.4	0.4	0.0	0.6	2.4	0.3	2.8	0.5	0.2
LBFDKA (n=1)	5.6	0.2	0.0	3.2	20.9	30.0	1.3	3.9	1.9	0.2	1.0	1.0	0.3	0.2	8.3	5.8	0.7	7.6	0.3	0.0	0.4	2.2	0.1	1.8	2.0	0.9
LBFIDT (n=1)	5.1	0.2	0.0	2.6	26.4	32.0	1.0	5.7	2.0	0.4	0.8	0.7	0.1	0.1	3.5	2.2	1.3	9.1	0.4	0.0	0.6	2.8	0.1	2.0	0.7	0.2

Table 140: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column; as defined in Table 131. In addition to those categories, the catergory “dc” was sub-divided into the category dc sl: all T1 plants where the average of all copy number assays listed in Table 135 was 3.51-4.49, and the zygocity analysis listed in Table 137 revelead a single locus insertion of both copies, and into the category dc dl: all T1 plants where the average of all copy number assays listed in Table 135 was 3.51-4.49, and the zygocity analysis listed in Table 137 revelead a double locus insertion of both copies. The number of T1 plants fullfilling these criteria are displayed in parentheses. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=172)	5.1 ± 0.9	0.2 ± 0.1	0 ± 0	2.8 ± 0.5	29.1 ± 3	33.8 ± 2.8	0.8 ± 0.2	4.8 ± 0.9	1.9 ± 0.7	0.3 ± 0.2	0.8 ± 0.1	0.8 ± 0.1	0.2 ± 0.2	0.1 ± 0.1	2.8 ± 0.3	1.5 ± 0.2	2.1 ± 0.4	7.9 ± 1.3	0.4 ± 0	0 ± 0	0.3 ± 0.1	1.9 ± 0.4	0.1 ± 0.1	1.4 ± 0.3	0.3 ± 0.1	0.3 ± 0.1
dc (n=813)	4.9 ± 0.4	0.2 ± 0	0 ± 0	2.9 ± 0.5	29.1 ± 2.6	32 ± 3.1	1.1 ± 0.3	5.3 ± 1.3	1.9 ± 1	0.3 ± 0.1	0.9 ± 0.2	0.7 ± 0.1	0.1 ± 0	0.1 ± 0	5.9 ± 1.7	3.1 ± 1.1	0.9 ± 0.5	5.1 ± 2.1	0.4 ± 0	0 ± 0	0.4 ± 0.1	1.7 ± 0.5	0.1 ± 0.6	1 ± 0.4	1.4 ± 0.7	0.3 ± 0.1
dc sl (n=700)	4.9 ± 0.4	0.2 ± 0	0 ± 0	2.8 ± 0.4	29.4 ± 2.5	31.9 ± 3.2	1.1 ± 0.3	5.4 ± 1.4	1.9 ± 1.1	0.3 ± 0.1	0.8 ± 0.2	0.7 ± 0.1	0.1 ± 0	0.1 ± 0	6 ± 1.7	3.2 ± 1.2	0.9 ± 0.6	4.8 ± 1.7	0.4 ± 0	0 ± 0	0.4 ± 0.2	1.7 ± 0.5	0.1 ± 0.6	0.9 ± 0.3	1.4 ± 0.7	0.3 ± 0.2
dc dl (n=64)	5 ± 0.5	0.2 ± 0	0 ± 0	3.2 ± 0.6	26.3 ± 2.5	32.2 ± 2.4	1.1 ± 0.2	4.5 ± 0.7	1.9 ± 0.4	0.3 ± 0.1	0.9 ± 0.1	0.7 ± 0.1	0.1 ± 0	0.1 ± 0	4.3 ± 1.1	2.5 ± 0.5	1.4 ± 0.3	9 ± 2	0.4 ± 0	0 ± 0	0.4 ± 0.1	2.4 ± 0.5	0.1 ± 0.1	1.7 ± 0.5	0.7 ± 0.3	0.3 ± 0.1

Table 141: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column as defined in the description

of Table 140. For each category, the fatty acid profile of the plant having the highest EPA+DHA levels was shown. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Category of T1 plants	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
sc (n=1)	6.4	0.1	0.0	3.0	23.7	34.1	0.9	3.6	4.0	0.4	1.0	0.9	0.2	0.1	3.1	1.3	3.3	10.3	0.4	0.0	0.3	1.9	0.1	1.8	0.2	0.3
dc (n=1)	4.6	0.1	0.0	2.3	19.8	35.1	0.6	3.9	2.7	0.3	0.6	0.7	0.2	0.1	4.3	1.8	4.6	11.4	0.3	0.0	0.6	3.9	0.1	1.1	0.4	0.3
dc sl (n=1)	4.8	0.1	0.0	2.3	19.8	35.1	0.6	3.9	2.7	0.3	0.6	0.7	0.2	0.1	4.3	1.8	4.6	11.4	0.3	0.0	0.6	3.9	0.1	1.1	0.4	0.3
dc dl (n=1)	4.6	0.3	0.0	2.7	20.4	31.3	0.8	3.9	2.3	0.3	0.7	0.5	0.2	0.1	3.9	2.5	2.4	13.7	0.3	0.0	0.3	2.6	0.2	2.9	0.4	0.2

Table 142: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
LBFDGG (n=50)	43.6 ± 2.7	9 ± 0	9 ± 0	9 ± 0	8.1 ± 1.6	3 ± 0	5 ± 0	5 ± 0	8.1 ± 1.6	4.5 ± 0.8	118.8 ± 6.1	4.4 ± 0.3	3.5 ± 0.9	36.1	30.2
LBFGKN (n=50)	43.3 ± 1.7	9 ± 0	9 ± 0	9 ± 0	8.1 ± 0.7	3 ± 0	5 ± 0	5 ± 0	8.1 ± 0.7	5.1 ± 0.8	112.4 ± 4.1	4.4 ± 0.3	3 ± 0.8	36.9	30.1
LBFIHE (n=34)	47.4 ± 5.1	9 ± 0	9 ± 0	9 ± 0	6.6 ± 1.6	3 ± 0	5 ± 0	5 ± 0	6.6 ± 1.6	5.6 ± 0.9	105.7 ± 6.3	4.2 ± 0.5	3.8 ± 0.6	36.0	29.4
LBFLDI (n=60)	35.8 ± 2.9	9 ± 0	7.5 ± 0.6	8.9 ± 0.7	8.2 ± 1.1	3 ± 0	4 ± 0.5	4 ± 0	8.4 ± 1.2	5.4 ± 0.9	94 ± 5.1	3.6 ± 0.8	4.8 ± 1.8	36.9	30.1
LBFPNF (n=52)	35.3 ± 2.2	9 ± 0	7.6 ± 0.6	8.8 ± 0.5	8.4 ± 0.6	3 ± 0	3.9 ± 0.3	4 ± 0	8.3 ± 1.2	5.3 ± 0.9	88.4 ± 7.9	3.6 ± 0.9	3.5 ± 0.7	39.1	28.3
LBFNSQ (n=51)	45.2 ± 7	9 ± 0	7.7 ± 0.9	6.8 ± 1.3	6.8 ± 1.2	3 ± 0	5 ± 0.2	4.1 ± 0.5	8.7 ± 0.6	5 ± 1	109.6 ± 10.9	3.4 ± 0.3	4.4 ± 1.8	37.5	28.7
LBFDGL (n=57)	43.9 ± 2.4	9 ± 0	9 ± 0	9 ± 0	7.7 ± 0.8	3 ± 0	5 ± 0	5 ± 0	7.7 ± 0.8	5.1 ± 0.8	109.4 ± 6.6	4.1 ± 0.4	2.8 ± 0.7	36.9	29.9
LBFIEF (n=6)	47.2 ± 5	9 ± 0	9 ± 0	9 ± 0	4 ± 2	3 ± 0	5 ± 0	5 ± 0	4 ± 2	6.2 ± 0.8	98.3 ± 4.1	3.4 ± 0.3	3.8 ± 1	38.9	29.9
LBFBAV (n=50)	46.6 ± 1.6	9 ± 0	7.4 ± 0.8	9 ± 0	8.9 ± 0.3	3 ± 0	5 ± 0	4 ± 0	9 ± 0	3.5 ± 0.5	125.1 ± 5.6	2.7 ± 0.3	3.9 ± 1	39.0	28.0
LBFPNC (n=32)	44.6 ± 4.2	9 ± 0	9 ± 0	9 ± 0	8.3 ± 0.7	3 ± 0	5 ± 0	5 ± 0	8.3 ± 0.7	5.5 ± 0.9	105.6 ± 5.6	4.1 ± 0.3	2.8 ± 0.5	39.4	28.3

LBFGHQ (n=46)	44.4 ± 4	9 ± 0	7.3 ± 1.9	9 ± 0	8.9 ± 0.3	3 ± 0	5 ± 0	4 ± 0	9 ± 0.1	3.9 ± 0.7	124.5 ± 6.2	2.6 ± 0.3	3.7 ± 0.9	38.3	27.8
LBFAZB (n=49)	47.6 ± 3.2	9 ± 0	9 ± 0	9 ± 0	7.9 ± 0.8	3 ± 0	5 ± 0	5 ± 0	7.9 ± 0.8	5.1 ± 0.8	112.3 ± 4.9	3.9 ± 0.4	2.6 ± 0.6	38.2	29.4
LBFGKW (n=72)	46.7 ± 1.9	9 ± 0	7.3 ± 0.5	9 ± 0	8.9 ± 0.3	3 ± 0	5 ± 0	4 ± 0	8.9 ± 0.3	4.1 ± 0.6	125.2 ± 6.2	2.6 ± 0.3	3.7 ± 0.8	38.8	27.9
LBFNRU (n=58)	41.4 ± 1.7	9 ± 0	7.6 ± 0.6	8.9 ± 0.7	8.2 ± 0.7	3 ± 0	5 ± 0	4 ± 0	8.9 ± 0.8	5.6 ± 0.8	117 ± 5	2.6 ± 0.3	3.6 ± 1.3	39.5	27.6
LBFGIZ (n=43)	41.5 ± 2.8	9 ± 0	7.6 ± 0.6	9 ± 0	8.3 ± 0.5	3 ± 0	5 ± 0	4 ± 0	8.9 ± 0.3	5.3 ± 0.9	113.5 ± 5.9	2.4 ± 0.2	3.9 ± 0.7	38.4	28.6
LBFIGM (n=56)	36.1 ± 1.3	9 ± 0	6.7 ± 0.8	9 ± 0.3	8.8 ± 0.4	3 ± 0	2.7 ± 0.7	4 ± 0	8.8 ± 0.5	3.9 ± 0.7	107.6 ± 9	2.7 ± 0.3	3.4 ± 0.8	39.1	28.6
LBFNRR (n=61)	41.3 ± 2.2	9 ± 0	7.8 ± 0.6	9 ± 0	8 ± 0.6	3 ± 0	5 ± 0	4 ± 0	9 ± 0	5.3 ± 0.6	116.5 ± 6.3	2.9 ± 0.3	3.2 ± 0.9	40.6	27.1
LBFNTK (n=69)	34.5 ± 2.8	8 ± 0	6.6 ± 1.1	9 ± 0	8.7 ± 0.5	3 ± 0	2.4 ± 0.6	4 ± 0	8.8 ± 0.7	3.7 ± 0.6	93.4 ± 8.2	2.8 ± 0.3	3.8 ± 0.8	39.8	28.3
LBFGJA (n=42)	45.1 ± 1	9 ± 0	9 ± 0	9 ± 0	7.6 ± 0.5	3 ± 0	5 ± 0	5 ± 0	7.6 ± 0.5	4.3 ± 1.1	113.3 ± 2.4	4.9 ± 0.2	2.4 ± 0.8	32.9	25.6
LBFIFV (n=58)	42.4 ± 0.6	9 ± 0	9 ± 0	9 ± 0	8.8 ± 0.6	3 ± 0	5 ± 0	5 ± 0	8.8 ± 0.6	4.5 ± 0.8	113.1 ± 2.4	4.2 ± 0.2	2.6 ± 0.6	37.3	29.4
LBFLER (n=52)	45.1 ± 3.5	9 ± 0	9 ± 0	9 ± 0	8.5 ± 0.7	3 ± 0	5 ± 0	5 ± 0	8.5 ± 0.7	5.6 ± 1	108.3 ± 6.8	3.9 ± 0.3	2.6 ± 0.7	40.8	27.7
LBFLDL (n=44)	44.7 ± 3.7	9 ± 0	9 ± 0	9 ± 0	8.5 ± 0.6	3 ± 0	5 ± 0	5 ± 0	8.5 ± 0.6	5.1 ± 0.8	109.3 ± 5.3	4 ± 0.2	2.6 ± 0.8	38.6	29.2
LBFNQW (n=51)	42.8 ± 1.9	9 ± 0	9 ± 0	9 ± 0	8.7 ± 0.5	3 ± 0	5 ± 0	5 ± 0	8.7 ± 0.5	5.7 ± 0.9	105.5 ± 6.3	4.1 ± 0.3	3.1 ± 0.5	38.4	28.9
LBFBAP (n=19)	43.3 ± 1.8	9 ± 0	9 ± 0	9 ± 0	8.9 ± 0.2	3 ± 0	5 ± 0	5 ± 0	8.9 ± 0.2	4.6 ± 0.8	117.4 ± 6.1	4 ± 0.5	2.4 ± 0.5	38.7	28.8
LBFDAU (n=10)	43.6 ± 1.7	9 ± 0	9 ± 0	9 ± 0	9 ± 0	3 ± 0	5 ± 0	5 ± 0	8.5 ± 1.6	4.4 ± 0.8	110 ± 5.8	4.5 ± 0.5	2.6 ± 0.5	34.5	30.2
LBFPRA (n=16)	47.8 ± 2.5	9 ± 0	7.9 ± 0.8	7.8 ± 0.4	7.4 ± 0.8	3 ± 0	5.2 ± 0.4	4 ± 0	9 ± 0	5.6 ± 0.8	123.4 ± 4	4.2 ± 0.6	2.3 ± 0.8	38.1	28.2
LBFIFU (n=11)	46.8 ± 6.4	9 ± 0	8.7 ± 0.9	8.7 ± 0.9	7.3 ± 1.1	3 ± 0	5 ± 0	5 ± 0	7.3 ± 1.1	5.6 ± 1.1	103.6 ± 8.1	3.8 ± 0.5	3.5 ± 0.9	37.4	28.7
LBFDKD (n=2)	43 ± 4.2	9 ± 0	9 ± 0	9 ± 0	7.5 ± 0.7	3 ± 0	5 ± 0	5 ± 0	7.5 ± 0.7	5 ± 1.4	107.5 ± 10.6	4.3 ± 0.8	4 ± 1.4	36.6	31.2
LBFDJG (n=12)	45.1 ± 1	9 ± 0	9 ± 0	9 ± 0	8.8 ± 0.6	3 ± 0	5 ± 0	5 ± 0	8.8 ± 0.6	4.3 ± 1	104.2 ± 29.8	3.8 ± 0.2	2.8 ± 0.5	37.7	29.8
LBFLFK (n=15)	42.5 ± 5.5	9 ± 0	7.9 ± 1.2	8.7 ± 1.3	8.1 ± 1.3	3 ± 0	4.9 ± 0.5	4 ± 0	8.9 ± 0.4	5.1 ± 1.2	113.7 ± 9	4.1 ± 1	3.7 ± 0.6	39.3	27.2
LBFLCG (n=15)	42.5 ± 0.6	9 ± 0	9 ± 0	9 ± 0	9 ± 0	3 ± 0	5 ± 0	5 ± 0	8.7 ± 1	4.5 ± 0.8	113.7 ± 2.3	4.3 ± 0.5	2.7 ± 0.8	37.7	29.1
LBFPQM (n=12)	42.7 ± 2.5	9 ± 0	9 ± 0	9 ± 0	8.7 ± 0.5	3 ± 0	5 ± 0	5 ± 0	8.7 ± 0.5	5.5 ± 1	110 ± 6	4.2 ± 0.5	2.8 ± 0.4	39.2	27.7
LBFDHG (n=5)	44.8 ± 3	9 ± 0	9 ± 0	9 ± 0	6.4 ± 0.9	3 ± 0	5 ± 0	5 ± 0	6.4 ± 0.9	4.2 ± 0.8	115 ± 0	4.2 ± 0.2	5 ± 0	33.5	28.0
LBFDKA (n=5)	48.6 ± 1.7	9 ± 0	9 ± 0	9 ± 0	9 ± 0	3 ± 0	5 ± 0	5 ± 0	9 ± 0	5.6 ± 0.9	108 ± 4.5	3.8 ± 0.2	2.4 ± 0.5	40.0	26.6
LBFIDT (n=7)	46.3 ± 1.3	9 ± 0	7.7 ± 0.5	9 ± 0	8 ± 0	3 ± 0	5 ± 0	4 ± 0	9 ± 0	4.1 ± 0.7	125.7 ± 6.7	2.5 ± 0.2	3.7 ± 0.5	38.1	28.0

Table 143: Phenotypic rating of T1 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. Plants of all events combined have been grouped into the categories indicated in the first column as defined in the description of Table 140. The number of T1 plants fullfilling these criteria are displayed in parentheses. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Category of T1 plants	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	oil	protein
sc (n=177)	41.5 ± 5.2	9 ± 0	8.6 ± 0.7	9 ± 0.4	7.9 ± 1.5	3 ± 0	4.8 ± 0.5	4.8 ± 0.4	8 ± 1.5	5.1 ± 1	109.1 ± 10.6	3.9 ± 0.6	3.8 ± 1.4	37 ± 1.4	29.5 ± 0.9
dc (n=781)	43.4 ± 4.4	8.9 ± 0.3	8.1 ± 1.1	9 ± 0.3	8.4 ± 0.8	3 ± 0	4.6 ± 0.9	4.5 ± 0.5	8.6 ± 0.8	4.7 ± 1.1	112.2 ± 11	3.3 ± 0.8	3.2 ± 1	38 ± 2.1	28.5 ± 1.2
dc sl (n=677)	43.1 ± 4.4	8.9 ± 0.3	8 ± 1.1	9 ± 0.2	8.5 ± 0.8	3 ± 0	4.6 ± 1	4.4 ± 0.5	8.7 ± 0.8	4.7 ± 1.1	112.3 ± 11	3.3 ± 0.8	3.2 ± 1	38.4 ± 1.8	28.3 ± 1.1
dc dl (n=55)	43.3 ± 3.3	9 ± 0	8.7 ± 0.8	8.9 ± 0.6	8.4 ± 1	3 ± 0	5 ± 0.3	4.8 ± 0.4	8.5 ± 1.1	4.8 ± 1.1	110.8 ± 14.3	3.5 ± 0.7	3.2 ± 0.9	36.6 ± 2.7	28.9 ± 1.7

Fatty acid profiles, copy number measurements, and phenotypic observations of T1 plants carrying T-DNAs of plasmids VC-LTM593-1qcz rc cultivated in field trials in USDA growth zone 11 during winter.

Certain events that had higher levels of EPA and DHA were tested in the field and examined for fatty acid profile, aerial phenotype (if any) and copy number in the T1 generation. A variety of constructs were examined including those with partial double copy insertions, single copy insertions and double copy insertions being represented (see Table 144). Table 145 indicates that LBFDAU had an EPA content of ca. 13% and a DHA content of ca. 3% of the total seed fatty acid content, and a maximum content for DHA of 3.6% and EPA of 17% of total seed fatty acids (Table 146). Measurements of single seeds from LBFDAU had as much as 26% EPA and 4.6% DHA, see Table 147. Overall the field performance of LBFDAU matched or exceeded that of the greenhouse.

Table 144: Copy number measurement of T1 plants cultivated in field, corresponding to USDA growth zone 11, during the winter for field trials of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T1 plants that where measured per event. The T1 plants underwent a selection from ~80 segregating T1 seedlings, using zygocity analysis similar to the selection performed in the greenhouse (which was illustrated in Table 137), keeping only plants that are homozygous for the desired number of loci. A copy number of ~2 therefore was indicative for one homozygous copy, a copy number of ~4 indicative for two homozygous copies (located either at on or at two different loci) and so forth. Odd results of 3, 5, 7, 9 etc indicate that at least some of the selected T1 plants carry at least one heterozygous locus. Homozygocity was indicated if the average result of the selected T1 plants was about two fold higher than the the result oberved in the T0 generation (indicated in parentheses). For some events this was not the case because during selection of T1 plants, undesired loci have been segregated out while retaining only desired loci in a homozygous state.

Event	Copy number assays targeting the T-DNA of VC-LTM593-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA) near the right T-DNA border.														
	c-AHAS	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-p-LuPXR_i-Atss15	j-p-PvARC5_t-BnSETL	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	j-p-BnSETL-v1_c-o3Des(Pir_GA)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Otfebit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)	Conclusion from individual assays: number of T-DNA copies inserted into the genome
LBFDGG (n=5)	2 (T0: 1.1)										1.9 (T0: 1)			1.9 (T0: 1)	single copy
LBFGKN (n=12)	2.1 (T0: 1)										2 (T0: 1)			1.9 (T0: 1.1)	single copy
LBFIHE (n=8)	2.1 (T0: 1)										1.9 (T0: 1.2)			1.9 (T0: 1.1)	single copy
LBFLDI (n=13)	2 (T0: 1)										1.9 (T0: 1)			1.8 (T0: 1)	single copy
LBFPNF (n=9)	2 (T0: 1.1)										3.7 (T0: 1.9)			3.3 (T0: 1.9)	partial double copy
LBFDAU (n=4)	2 (T0: 1.1)										3.8 (T0: 2.4)			3.6 (T0: 1.9)	partial double copy
LBFPRA (n=5)	3.2 (T0: 2)										4.9 (T0: 3.1)			4 (T0: 2.8)	partial double copy
LBFLFK (n=4)	3.9 (T0: 2)										3.4 (T0: 2.4)			3.4 (T0: 2)	partial double copy
LBFLCG (n=3)	4.3 (T0: 1.9)										2.9 (T0: 2.5)			3.4 (T0: 2)	partial double copy
LBFPQM (n=1)	3.7 (T0: 2)										(T0: 2)			3.9 (T0: 1.8)	partial double copy

Table 145: Fatty acid profiles of T2 seeds harvested from T1 plants cultivated in the field, corresponding to USDA growth zone 11, during winter of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T2 seed batches that were measured per event. Per seed batch a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDGG (n=5)	4.4 ± 0.2	0.2 ± 0	0.1 ± 0	2.4 ± 0.1	32.3 ± 1.9	34.4 ± 1.6	0.7 ± 0	5.3 ± 0.6	1.5 ± 0.1	0.4 ± 0.1	0.6 ± 0	0.7 ± 0	0.1 ± 0	0 ± 0	2 ± 0.2	1.1 ± 0.2	2.7 ± 0.3	6.9 ± 0.7	0.3 ± 0	0 ± 0	0.3 ± 0	1.9 ± 0.2	0.1 ± 0	1.4 ± 0.3	0 ± 0	0.1 ± 0
LBFGKN (n=12)	4.8 ± 0.3	0.2 ± 0	0.1 ± 0	2.6 ± 0.3	27.8 ± 1.9	36 ± 1.3	0.5 ± 0.1	4.8 ± 0.7	1.5 ± 0.2	0.4 ± 0.1	0.7 ± 0.1	0.7 ± 0	0.2 ± 0.1	0.1 ± 0	2.3 ± 0.2	1.1 ± 0.2	3.3 ± 0.4	8 ± 0.8	0.3 ± 0.1	0 ± 0	0.4 ± 0.1	1.9 ± 0.3	0.1 ± 0	1.8 ± 0.4	0.1 ± 0	0.2 ± 0
LBFIHE (n=8)	4.9 ± 0.8	0.3 ± 0.1	0.1 ± 0	2.4 ± 0.4	30.8 ± 3.1	36.1 ± 1.2	0.5 ± 0.1	5.4 ± 1.3	1.5 ± 0.5	0.3 ± 0.1	0.7 ± 0.1	0.7 ± 0.1	0.2 ± 0	0.1 ± 0	1.9 ± 0.5	0.9 ± 0.1	2.8 ± 0.7	6.4 ± 1.1	0.3 ± 0	0 ± 0	0.5 ± 0.1	1.7 ± 0.3	0.1 ± 0	1.3 ± 0.2	0 ± 0.1	0.1 ± 0
LBFLDI (n=13)	4.5 ± 1.1	0.2 ± 0.1	0.1 ± 0	2.3 ± 0.6	30 ± 5.9	35.4 ± 6.1	0.5 ± 0.1	4.1 ± 0.8	1.3 ± 0.3	0.3 ± 0.1	0.6 ± 0.1	0.7 ± 0.1	0.2 ± 0.1	0.1 ± 0	1.9 ± 0.5	0.8 ± 0.2	2.9 ± 0.8	6.4 ± 1.6	0.3 ± 0.1	0 ± 0	0.4 ± 0.1	1.6 ± 0.3	0.1 ± 0.1	1.3 ± 0.4	0.1 ± 0	0.1 ± 0
LBFPNF (n=9)	4.7 ± 0.2	0.2 ± 0	0.1 ± 0	2.4 ± 0.3	29.2 ± 1.8	31.7 ± 1	1.1 ± 0.1	4 ± 0.6	2.6 ± 1.4	0.6 ± 0.1	0.7 ± 0	0.7 ± 0	0.1 ± 0	0 ± 0	3.3 ± 0.4	1.2 ± 0.1	4.2 ± 0.5	8.4 ± 1.1	0.3 ± 0	0 ± 0	0.5 ± 0.1	2.3 ± 0.4	0.1 ± 0	1.5 ± 0.3	0.1 ± 0.1	0.1 ± 0
LBFDAU (n=4)	4.6 ± 0.2	0.2 ± 0	0.1 ± 0	2.3 ± 0.3	24.3 ± 3.7	31.2 ± 2.5	0.8 ± 0.1	5.2 ± 0.6	2.2 ± 0.5	0.4 ± 0.1	0.6 ± 0	0.7 ± 0.1	0.1 ± 0	0.1 ± 0	2.5 ± 0.4	1.7 ± 0.5	2.9 ± 0.4	13.4 ± 3.4	0.3 ± 0	0 ± 0	0.3 ± 0	2.7 ± 0.7	0.1 ± 0	2.7 ± 0.7	0.1 ± 0.1	0.2 ± 0
LBFPRA (n=5)	4.8 ± 0.2	0.2 ± 0	0.1 ± 0	2.5 ± 0.4	25.1 ± 0.9	34.5 ± 2.4	0.9 ± 0.2	4.4 ± 0.7	2.2 ± 0.2	0.4 ± 0.1	0.6 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	2.6 ± 0.6	1.3 ± 0.3	3.6 ± 0.6	10.7 ± 1.9	0.3 ± 0	0 ± 0	0.5 ± 0.1	2.3 ± 0.3	0.1 ± 0	1.7 ± 0.2	0.1 ± 0.1	0.2 ± 0.1
LBFLFK (n=4)	5.1 ± 0.8	0.2 ± 0.1	0.1 ± 0	2.1 ± 0.4	27 ± 4.3	32.3 ± 0.5	0.8 ± 0.1	5.4 ± 0.8	1.9 ± 0.5	0.4 ± 0	0.6 ± 0.1	0.7 ± 0.1	0.2 ± 0	0.1 ± 0	3.1 ± 0.6	1.7 ± 0.3	2.7 ± 0.5	9.5 ± 1.8	0.3 ± 0	0 ± 0	0.5 ± 0.2	2.9 ± 0.4	0.2 ± 0.1	2.1 ± 0.5	0.3 ± 0.1	0.2 ± 0
LBFLCG (n=3)	4.8 ± 0.2	0.2 ± 0	0.1 ± 0	3 ± 0.3	26.4 ± 1.3	33.3 ± 1	0.8 ± 0	4.7 ± 0.7	2 ± 0.2	0.5 ± 0.1	0.7 ± 0	0.7 ± 0	0.1 ± 0	0.1 ± 0	2.3 ± 0.1	1.2 ± 0.1	2.9 ± 0.2	9.9 ± 0.9	0.3 ± 0	0 ± 0	0.7 ± 0.1	2.6 ± 0.3	0.2 ± 0	2.3 ± 0.5	0.2 ± 0	0.2 ± 0
LBFPQM (n=1)	5.0	0.2	0.1	2.7	26.1	30.8	1.0	4.3	2.3	0.5	0.7	0.6	0.1	0.1	3.4	1.8	2.8	10.8	0.3	0.0	0.5	2.5	0.3	2.5	0.4	0.2

Table 146: Fatty acid profiles of one T2 seed batch per event harvested from T1 plants cultivated in the field, corresponding to USDA growth zone 11, during winter of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column. Fatty acid

profiles of T2 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1n-7	16:3n-3	18:0	18:1n-9	18:2n-6	18:2n-9	18:3n-3	18:3n-6	18:4n-3	20:0	20:1n-9	20:2n-6	20:3n-3	20:3n-6	20:4n-3	20:4n-6	20:5n-3	22:0	22:1n-9	22:4n-6	22:5n-3	22:5n-6	22:6n-3	22:4n-3	20:2n-9
LBFDGG (n=1)	4.5	0.21	0.1	2.4	29.86	33.45	0.71	5.74	1.69	0.45	0.62	0.74	0.12	0.05	2.25	1.38	2.83	8.02	0.29	0	0.35	2.21	0.1	1.79	0	0.13
LBFGKN (n=1)	4.5	0.21	0.09	2.28	26.68	34.29	0.65	4.99	1.73	0.42	0.61	0.69	0.23	0.1	2.43	1.22	3.34	9.74	0.31	0	0.48	2.27	0.17	2.31	0	0.23
LBFIHE (n=1)	4.8	0.22	0.09	2.95	26.2	38.09	0.52	3.19	2.12	0.22	0.78	0.69	0.15	0	2.73	1.03	3.67	8.16	0.35	0	0.59	1.72	0.12	1.55	0	0.09
LBFLDI (n=1)	4.8	0.24	0.09	2.51	27.6	35.76	0.54	4.15	1.66	0.26	0.7	0.69	0.29	0.1	2.63	1.16	3.5	8.32	0.31	0	0.47	1.89	0.19	1.85	0.15	0.21
LBFPNF (n=1)	4.9	0.27	0.13	2.11	26.29	31.14	0.91	5.04	1.72	0.68	0.67	0.7	0.11	0.04	2.8	1.34	4.26	10.24	0.36	0	0.54	3.24	0.14	2.09	0.15	0.12
LBFDAU (n=1)	4.8	0.23	0.14	1.94	20.37	28.27	0.98	5.23	2.78	0.5	0.63	0.62	0.13	0.13	3.08	2.3	2.51	17.57	0.36	0	0.29	3.16	0.09	3.62	0	0.25
LBFPRA (n=1)	4.7	0.16	0.14	1.92	25.56	32.27	1.21	4.87	2.09	0.44	0.51	0.66	0.13	0.07	2.34	1.29	3.67	12.46	0.28	0	0.44	2.58	0.08	1.8	0.08	0.26
LBFLFK (n=1)	4.9	0.21	0.12	2.34	22.43	32.9	0.9	4.55	2.5	0.42	0.66	0.62	0.13	0.07	3.86	2.18	2.37	11.06	0.3	0	0.76	3.2	0.24	2.66	0.46	0.21
LBFLCG (n=1)	5.0	0.27	0.12	2.65	24.88	32.2	0.74	5.16	2.3	0.46	0.69	0.65	0.14	0.09	2.24	1.36	2.85	10.87	0.31	0	0.69	2.92	0.22	2.82	0.21	0.15
LBFPQM (n=1)	5.0	0.22	0.11	2.67	26.07	30.83	1.02	4.34	2.31	0.45	0.69	0.63	0.12	0.07	3.4	1.75	2.78	10.78	0.3	0	0.54	2.53	0.27	2.5	0.4	0.23

Table 147: Fatty acid profiles of 95 single seeds of the one seedbatch of event LBFDAU shown in Table 146 having highest EPA+DHA levels .

Event	16:0	16:1n-7	16:3n-3	18:0	18:1 n-9	18:2 n-6	18:2n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3n-6	20:4 n-3	20:4n-6	20:5n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDAU seed 1	4.2	0.2	0.2	2.1	11.3	26.5	1.2	3.8	4.3	0.6	0.7	0.5	0.1	0.1	3.3	3.0	1.9	26.2	0.4	0.0	0.6	3.7	0.2	4.9	0.0	0.2
LBFDAU seed 2	5.5	0.3	0.1	2.5	14.3	25.0	0.8	4.5	2.5	0.5	0.7	0.5	0.2	0.1	3.0	2.5	2.5	23.6	0.5	0.0	0.5	3.8	0.3	5.8	0.0	0.2
LBFDAU seed 3	5.1	0.3	0.1	2.0	16.0	25.5	1.2	4.4	3.4	0.6	0.7	0.5	0.1	0.1	3.4	2.5	2.5	23.1	0.3	0.0	0.6	3.3	0.1	4.2	0.0	0.2
LBFDAU seed 4	6.7	0.4	0.2	3.8	15.8	23.5	1.5	4.9	3.3	0.9	1.2	0.5	0.0	0.0	1.7	1.3	1.9	21.2	0.7	0.0	0.8	3.5	0.4	5.8	0.0	0.0
LBFDAU seed 5	5.4	0.4	0.2	1.5	16.1	24.4	1.0	5.4	3.4	0.8	0.6	0.5	0.1	0.1	2.9	2.1	3.5	22.0	0.3	0.0	0.5	3.7	0.2	4.8	0.0	0.2
LBFDAU seed 6	5.5	0.3	0.1	1.9	16.6	25.6	0.9	5.3	3.3	0.7	0.7	0.6	0.1	0.1	2.9	2.3	2.4	21.8	0.3	0.0	0.4	3.4	0.2	4.4	0.0	0.2
LBFDAU seed 7	5.0	0.4	0.2	2.4	16.3	25.3	1.1	4.6	3.5	0.6	0.7	0.5	0.1	0.0	3.6	3.1	2.0	21.9	0.5	0.0	0.5	3.5	0.0	4.3	0.0	0.1
LBFDAU seed 8	5.3	0.3	0.1	2.3	17.4	26.0	1.2	4.1	3.7	0.7	0.7	0.5	0.1	0.1	2.6	2.0	2.7	21.7	0.4	0.0	0.4	3.1	0.2	4.0	0.0	0.2
LBFDAU seed 9	5.3	0.2	0.2	2.4	14.3	27.8	1.0	4.0	4.2	0.6	0.7	0.5	0.1	0.1	3.6	2.9	2.3	21.1	0.4	0.0	0.5	2.8	0.3	4.4	0.0	0.1
LBFDAU seed 10	6.7	0.5	0.2	2.8	15.8	23.3	0.8	5.7	2.9	0.8	0.9	0.5	0.0	0.0	3.1	2.4	2.2	19.8	0.8	0.0	0.6	4.7	0.1	5.4	0.0	0.0
LBFDAU seed 11	5.9	0.6	0.2	3.4	19.3	22.2	1.5	4.0	3.1	0.7	0.9	0.6	0.0	0.0	3.0	2.1	2.0	20.8	0.8	0.0	0.2	4.6	0.0	4.2	0.0	0.0
LBFDAU seed 12	5.2	0.4	0.2	2.2	16.1	25.2	0.8	5.5	3.3	0.7	0.8	0.5	0.1	0.1	3.7	2.9	2.4	20.1	0.4	0.0	0.4	4.2	0.2	4.7	0.0	0.2
LBFDAU seed 13	4.3	0.2	0.1	2.0	17.5	27.7	1.2	4.9	2.9	0.5	0.6	0.6	0.1	0.1	2.9	2.3	2.6	20.7	0.3	0.0	0.4	3.6	0.2	4.1	0.0	0.2
LBFDAU seed 14	4.2	0.3	0.1	2.0	16.4	27.9	0.9	5.1	2.9	0.5	0.6	0.5	0.1	0.1	3.5	3.2	2.0	20.5	0.3	0.0	0.4	3.7	0.1	4.3	0.0	0.2
LBFDAU seed 15	4.5	0.4	0.1	1.5	17.0	25.7	1.1	5.3	2.9	0.6	0.5	0.6	0.1	0.1	3.4	2.4	2.9	19.7	0.3	0.0	0.5	4.8	0.3	5.1	0.0	0.3
LBFDAU seed 16	4.7	0.6	0.2	2.0	17.2	25.9	1.1	5.9	3.0	0.7	0.7	0.5	0.1	0.0	3.2	2.6	2.3	20.1	0.6	0.0	0.7	3.4	0.1	4.3	0.0	0.2

LBFDAU seed 17	4.5	0.3	0.1	2.3	18.4	27.0	1.5	4.6	3.4	0.7	0.7	0.6	0.1	0.0	2.7	1.9	2.8	20.8	0.5	0.0	0.6	2.8	0.1	3.5	0.0	0.2
LBFDAU seed 18	5.1	0.2	0.2	2.9	16.1	27.1	1.5	4.7	4.2	0.7	0.9	0.7	0.0	0.0	2.3	2.3	2.1	19.5	0.7	0.0	0.4	3.4	0.0	4.8	0.0	0.2
LBFDAU seed 19	4.5	0.3	0.1	1.7	18.7	27.0	1.4	4.5	2.9	0.4	0.5	0.6	0.1	0.1	3.1	2.1	2.9	19.8	0.2	0.0	0.5	3.7	0.2	4.3	0.0	0.4
LBFDAU seed 20	5.3	0.2	0.1	2.6	17.9	26.4	1.1	4.4	2.9	0.5	0.7	0.6	0.1	0.1	3.4	2.7	2.8	20.8	0.3	0.0	0.4	3.0	0.1	3.3	0.0	0.2
LBFDAU seed 21	5.2	0.3	0.2	2.1	16.3	27.8	0.7	5.1	3.5	0.7	0.7	0.6	0.2	0.1	3.1	2.4	2.7	19.7	0.4	0.0	0.5	3.6	0.2	4.0	0.0	0.1
LBFDAU seed 22	4.8	0.2	0.1	2.4	17.7	28.9	0.9	4.9	3.1	0.5	0.7	0.6	0.1	0.1	2.4	2.1	2.7	19.9	0.3	0.0	0.4	3.0	0.1	3.8	0.0	0.2
LBFDAU seed 23	4.5	0.2	0.1	1.6	19.4	26.9	1.3	5.6	2.8	0.5	0.5	0.6	0.1	0.1	3.0	2.3	3.1	19.1	0.2	0.0	0.4	3.7	0.1	3.7	0.0	0.2
LBFDAU seed 24	6.6	0.6	0.2	3.4	18.4	23.0	1.0	3.9	4.6	1.1	1.1	0.7	0.0	0.0	3.6	2.0	1.6	17.9	0.7	0.0	0.9	3.7	0.0	4.8	0.0	0.0
LBFDAU seed 25	5.2	0.3	0.2	2.1	16.0	26.6	0.9	4.9	3.7	0.8	0.7	0.6	0.0	0.0	3.9	2.6	2.8	18.0	0.6	0.0	0.7	4.6	0.3	4.4	0.0	0.1
LBFDAU seed 26	5.5	0.6	0.2	2.6	19.9	23.4	2.1	3.8	3.0	0.6	0.8	0.6	0.0	0.0	4.0	2.0	2.8	18.5	0.6	0.0	1.0	3.8	0.2	3.9	0.0	0.2
LBFDAU seed 27	4.5	0.3	0.1	1.7	19.5	26.6	1.5	5.2	2.3	0.5	0.5	0.6	0.1	0.1	3.6	2.5	2.6	18.6	0.3	0.0	0.5	4.1	0.2	3.8	0.0	0.4
LBFDAU seed 28	5.1	0.3	0.2	2.5	17.2	27.3	0.8	4.6	2.9	0.5	0.9	0.5	0.1	0.0	3.7	2.3	3.6	18.6	0.5	0.0	0.5	3.7	0.2	3.8	0.0	0.2
LBFDAU seed 29	5.0	0.3	0.2	3.2	20.0	28.0	1.3	4.7	2.9	0.5	0.9	0.6	0.1	0.0	2.2	1.5	2.3	18.5	0.4	0.0	0.5	2.8	0.2	3.6	0.0	0.2
LBFDAU seed 30	4.7	0.2	0.1	2.4	18.6	29.3	1.6	4.4	3.2	0.5	0.7	0.6	0.1	0.1	2.9	2.1	2.5	18.6	0.3	0.0	0.7	2.7	0.2	3.2	0.0	0.2
LBFDAU seed 31	4.9	0.3	0.1	2.5	18.8	28.0	1.5	4.1	3.0	0.4	0.8	0.6	0.1	0.1	3.9	2.8	1.8	18.2	0.4	0.0	0.6	3.1	0.2	3.6	0.0	0.3
LBFDAU seed 32	4.8	0.3	0.1	2.2	19.6	28.3	1.0	5.5	2.6	0.5	0.6	0.6	0.1	0.1	3.1	2.5	2.4	18.3	0.3	0.0	0.4	3.1	0.1	3.4	0.0	0.2
LBFDAU seed 33	4.6	0.3	0.1	2.3	19.6	28.4	1.3	5.2	3.1	0.6	0.8	0.6	0.1	0.0	2.7	2.0	2.4	18.2	0.4	0.0	0.5	3.1	0.1	3.5	0.0	0.2
LBFDAU seed 34	4.9	0.3	0.1	3.4	19.2	25.9	1.8	4.0	3.1	0.5	1.0	0.7	0.1	0.0	3.9	2.7	2.1	17.9	0.5	0.0	0.6	3.0	0.2	3.7	0.0	0.3
LBFDAU seed 35	4.6	0.3	0.2	2.0	19.1	28.5	1.1	5.7	3.0	0.6	0.6	0.6	0.1	0.1	3.0	2.3	2.6	17.9	0.3	0.0	0.4	3.3	0.1	3.6	0.0	0.2
LBFDAU seed 36	4.2	0.2	0.1	2.1	18.1	30.5	1.0	4.9	2.9	0.4	0.6	0.6	0.1	0.1	3.5	3.0	2.1	17.6	0.3	0.0	0.4	3.2	0.1	3.8	0.0	0.2

LBFDAU seed 37	4.9	0.2	0.1	2.0	19.0	29.0	1.1	5.0	3.0	0.5	0.6	0.6	0.1	0.1	3.1	2.2	2.9	17.8	0.3	0.0	0.4	3.0	0.2	3.5	0.0	0.2
LBFDAU seed 38	4.4	0.3	0.1	1.9	19.7	29.9	1.2	4.5	2.6	0.4	0.6	0.5	0.1	0.1	3.0	2.0	2.6	17.8	0.3	0.0	0.5	3.4	0.2	3.5	0.0	0.2
LBFDAU seed 39	4.8	0.2	0.1	2.2	19.2	28.6	1.0	5.0	2.4	0.4	0.6	0.6	0.1	0.1	4.0	3.2	1.9	17.8	0.3	0.0	0.5	3.1	0.1	3.4	0.0	0.3
LBFDAU seed 40	4.3	0.3	0.1	1.8	20.2	28.8	1.4	4.8	2.6	0.4	0.6	0.6	0.1	0.1	3.2	2.2	2.5	17.7	0.3	0.0	0.5	3.6	0.2	3.5	0.0	0.3
LBFDAU seed 41	5.8	0.4	0.2	3.0	19.3	26.9	0.9	4.6	3.6	0.7	1.0	0.6	0.0	0.0	3.1	1.8	2.1	17.7	0.7	0.0	1.0	3.1	0.1	3.5	0.0	0.0
LBFDAU seed 42	4.6	0.3	0.1	2.3	21.3	27.8	1.2	5.2	2.8	0.6	0.6	0.6	0.1	0.1	2.7	2.1	2.3	18.0	0.3	0.0	0.7	2.9	0.1	3.2	0.0	0.2
LBFDAU seed 43	5.3	0.3	0.2	2.0	18.1	29.2	1.0	4.2	3.1	0.5	0.7	0.6	0.1	0.1	3.4	2.1	3.7	17.6	0.3	0.0	0.5	3.5	0.2	3.4	0.0	0.2
LBFDAU seed 44	4.7	0.3	0.2	1.9	19.3	29.3	1.0	5.7	2.7	0.5	0.7	0.7	0.1	0.1	2.7	2.1	2.6	17.3	0.3	0.0	0.5	3.6	0.2	3.6	0.0	0.2
LBFDAU seed 45	4.3	0.2	0.1	2.2	19.4	29.8	1.1	5.0	2.5	0.4	0.7	0.6	0.1	0.1	3.3	2.6	2.4	17.7	0.3	0.0	0.5	3.2	0.2	3.2	0.0	0.2
LBFDAU seed 46	4.5	0.2	0.2	2.4	18.8	29.0	1.1	5.0	3.7	0.6	0.7	0.6	0.1	0.1	3.1	2.2	2.8	17.1	0.3	0.0	0.5	3.1	0.2	3.5	0.0	0.2
LBFDAU seed 47	4.0	0.2	0.1	1.8	19.2	30.1	1.3	4.9	2.9	0.4	0.6	0.6	0.1	0.1	3.5	2.5	2.6	17.0	0.3	0.0	0.5	3.5	0.2	3.5	0.0	0.3
LBFDAU seed 48	4.3	0.2	0.1	2.0	20.0	30.1	1.3	4.5	2.7	0.4	0.6	0.5	0.1	0.1	3.5	2.3	2.7	16.9	0.3	0.0	0.4	3.1	0.2	3.5	0.0	0.3
LBFDAU seed 49	4.4	0.2	0.1	2.5	18.3	30.1	1.6	3.7	3.2	0.5	0.8	0.6	0.1	0.1	4.3	3.3	2.0	17.2	0.4	0.0	0.4	2.5	0.2	3.2	0.0	0.3
LBFDAU seed 50	4.3	0.3	0.1	1.9	21.5	29.2	1.3	5.2	2.5	0.5	0.6	0.6	0.1	0.1	2.8	2.1	2.3	17.0	0.3	0.0	0.4	3.2	0.2	3.3	0.0	0.2
LBFDAU seed 70	5.3	0.3	0.2	3.1	20.0	28.7	1.4	4.1	3.0	0.4	1.0	0.6	0.1	0.1	3.5	2.3	2.3	16.8	0.5	0.0	0.5	2.4	0.2	3.2	0.0	0.3
LBFDAU seed 71	4.2	0.2	0.1	2.0	22.1	29.1	1.7	4.9	2.3	0.3	0.6	0.6	0.1	0.1	2.9	2.3	2.2	16.7	0.3	0.0	0.7	2.7	0.2	3.3	0.0	0.3
LBFDAU seed 75	4.7	0.2	0.1	2.4	21.4	28.0	2.2	4.8	2.5	0.4	0.7	0.6	0.1	0.1	3.1	2.2	2.4	17.2	0.4	0.0	0.5	2.7	0.2	2.8	0.0	0.3
LBFDAU seed 76	4.7	0.3	0.1	2.1	20.9	28.1	1.0	5.4	3.1	0.6	0.6	0.6	0.1	0.1	2.9	2.1	2.6	16.3	0.3	0.0	0.6	3.4	0.2	3.7	0.0	0.2
LBFDAU seed 77	5.0	0.2	0.1	2.1	18.5	29.7	1.6	4.8	2.9	0.5	0.7	0.6	0.1	0.1	3.9	2.9	2.4	16.7	0.3	0.0	0.5	2.8	0.2	3.3	0.0	0.2
LBFDAU seed 78	4.8	0.2	0.1	1.9	20.1	29.2	1.1	5.1	2.6	0.4	0.6	0.7	0.1	0.1	3.4	2.4	2.7	16.7	0.3	0.0	0.7	3.2	0.2	3.2	0.0	0.2

LBFDAU seed 79	4.3	0.2	0.1	1.9	21.6	28.7	1.5	5.1	2.6	0.4	0.5	0.6	0.1	0.1	3.3	2.3	2.6	16.6	0.3	0.0	0.6	2.9	0.2	3.3	0.0	0.4
LBFDAU seed 80	4.7	0.3	0.2	1.9	19.0	31.0	0.7	4.6	2.7	0.5	0.6	0.6	0.1	0.0	3.3	2.2	2.5	16.1	0.4	0.0	0.6	3.8	0.3	3.7	0.0	0.1
LBFDAU seed 81	4.3	0.2	0.1	2.1	21.0	29.5	1.4	5.1	2.6	0.4	0.6	0.6	0.1	0.1	3.4	2.5	2.3	16.7	0.3	0.0	0.4	3.1	0.1	2.9	0.0	0.2
LBFDAU seed 82	4.5	0.3	0.1	2.0	21.0	29.6	1.4	5.5	2.5	0.5	0.6	0.6	0.1	0.1	2.7	1.9	2.7	16.2	0.3	0.0	0.5	3.2	0.2	3.5	0.0	0.3
LBFDAU seed 83	5.0	0.3	0.1	2.3	20.6	28.3	0.9	5.8	2.8	0.6	0.6	0.6	0.1	0.1	3.0	2.4	2.5	16.2	0.4	0.0	0.5	3.3	0.1	3.3	0.0	0.2
LBFDAU seed 84	6.2	0.5	0.2	2.9	20.3	27.1	0.8	5.6	3.0	0.9	0.9	0.6	0.0	0.0	3.0	2.1	2.1	15.4	0.7	0.0	0.5	3.5	0.0	3.9	0.0	0.0
LBFDAU seed 85	4.1	0.2	0.1	2.2	21.5	30.4	1.4	4.8	2.6	0.4	0.6	0.6	0.1	0.1	3.1	2.4	2.3	16.1	0.4	0.0	0.5	2.6	0.2	3.1	0.0	0.4
LBFDAU seed 86	4.7	0.3	0.2	2.2	20.6	30.6	1.0	5.5	2.8	0.5	0.7	0.6	0.1	0.1	2.7	2.0	2.7	15.5	0.4	0.0	0.5	2.7	0.2	3.2	0.0	0.2
LBFDAU seed 87	4.3	0.3	0.1	2.2	20.9	31.0	1.6	4.5	2.7	0.3	0.6	0.6	0.1	0.1	3.3	2.2	2.1	15.6	0.3	0.0	0.9	2.8	0.2	3.0	0.0	0.3
LBFDAU seed 88	4.1	0.2	0.1	1.9	22.2	30.6	1.3	4.6	2.5	0.5	0.5	0.6	0.1	0.1	2.9	1.7	3.1	15.6	0.3	0.0	0.7	3.0	0.2	2.9	0.0	0.3
LBFDAU seed 89	4.4	0.3	0.1	2.0	21.6	30.5	1.2	5.4	2.3	0.4	0.6	0.6	0.1	0.1	2.9	2.1	2.2	15.3	0.4	0.0	0.7	3.3	0.1	3.1	0.0	0.2
LBFDAU seed 90	4.8	0.2	0.1	2.4	22.3	29.6	1.1	5.2	2.3	0.4	0.7	0.6	0.1	0.1	3.2	2.6	2.2	15.6	0.3	0.0	0.5	2.7	0.1	2.7	0.0	0.3
LBFDAU seed 91	4.8	0.2	0.1	2.2	22.0	30.2	1.3	4.9	2.7	0.6	0.7	0.7	0.1	0.0	3.2	2.2	2.5	15.1	0.3	0.0	0.4	2.5	0.2	3.0	0.0	0.3
LBFDAU seed 92	5.2	0.3	0.2	2.0	20.3	29.7	1.1	5.1	3.2	0.6	0.6	0.6	0.1	0.0	3.1	1.9	3.4	14.8	0.4	0.0	0.6	3.3	0.2	3.2	0.0	0.2
LBFDAU seed 93	4.7	0.2	0.1	2.4	23.0	30.3	1.1	5.3	2.1	0.5	0.7	0.7	0.1	0.1	3.0	2.2	2.2	15.1	0.3	0.0	0.4	2.7	0.1	2.5	0.0	0.3
LBFDAU seed 94	5.0	0.3	0.2	2.3	21.9	30.6	1.3	5.2	2.4	0.7	0.8	0.6	0.1	0.1	2.9	2.1	2.4	14.7	0.4	0.0	0.4	2.7	0.2	2.8	0.0	0.3
LBFDAU seed 95	4.8	0.2	0.1	2.5	24.6	29.6	1.3	5.2	2.1	0.5	0.7	0.7	0.1	0.1	3.2	2.2	2.4	13.5	0.3	0.0	0.5	2.2	0.1	2.5	0.0	0.3

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LTM593-1qcz rc cultivated in greenhouses during the summer

The data in Table 148 indicate the copy number of the selected events was a single insertion which was homozygous in the T3 seed. Fatty acid profile measurements, see Table 149 and Table 150, indicated the combination of T-DNA from VC-LTM593-1qcz rc are capable of bringing in the VLC-PUFA pathway to successfully accumulate ARA, EPA and DHA. The data on Table 151 show that there was no significant impact on the aerial portion of the plant caused by VC-LTM593-1qcz rc.

Table 148: Copy number measurement of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T2 plants that where measured per event. For each event, T2 seedbatches of two homozygous T1 plants where selected for seeding. Comparison of the results with Table 135 confirmes homozygozity of all T2 plants.

Event	Copy number assays targeting the T-DNA of VC-LTM593-1qcz rc. Assays are listed according to the position of the assay target along the T-DNA, with target c-AHAS located near the left T-DNA border and target c-d6Elo(Pp_GA) near the right T-DNA border.															
	c-AHAS	j-i-Atss1_c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	j-p-LuPXR_i-Atss15	j-p-PvARC5_t-BnSETL	c-d5Des(Tc_GA)	j-i-Atss18_c-o3Des(Pi_GA2)	c-o3Des(Pi_GA)	j-p-BnSETL-v1_c-o3DES(Pir_GA)	j-i-Atss14_c-d12Des(Ps_GA)	c-d6Elo(Tp_GA)	j-t-StCAT_p2_p-LuPXR	j-i-Atss2_c-d6Des(Ot febit_GA)	c-d5Des(Tc_GA)	c-d6Elo(Pp_GA)	j-i-Atss18_c-d6Elo(Pp_GA2)
LBFDAU (n=218)	2.0	2.1	4.1		3.8	8.1	4.0	4.0			4.1	4.2	4.0	8.1	4.1	4.0
LBFDGG (n=200)	2.0	2.0	2.0		2.0	4.0	2.0	2.0			2.1	2.1	2.0	4.0	2.2	2.1
LBFGKN (n=182)	2.0	2.0	2.0		2.0	4.2	2.1	1.9			2.0	2.2	2.0	4.2	2.1	2.1
LBFIHE (n=157)	2.1	2.0	2.0		2.1	4.3	2.0	2.0			2.2	2.1	2.0	4.3	2.1	2.0
LBFLDI (n=229)	2.3	2.2	2.3		2.3	4.7	2.3	2.3			2.4	2.4	2.3	4.7	2.4	2.2
LBFPRA (n=196)	2.0	1.9	5.8		3.9	7.9	4.0	4.1			3.9	4.0	3.9	7.9	4.0	1.9
LBFDHG (n=177)	4.1	4.2	4.2		4.0	8.3	4.1	4.1			4.2	4.1	4.0	8.3	4.1	4.0
LBFLFK (n=195)	4.0	4.1	4.0		4.0	8.2	4.0	4.0			4.0	4.0	4.0	8.2	4.0	4.0

Table 149: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T3 seed batches representing a plant measured per event. Per seed batch a random selection of ~15 seed was measured in five technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDAU (n=218)	4.8 ± 0.2	0.2 ± 0	0 ± 0	4.2 ± 0.3	23 ± 1.6	31.5 ± 1.2	1.1 ± 0.2	4.6 ± 0.4	2.2 ± 0.4	0.4 ± 0.1	1 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	4.5 ± 0.8	3.2 ± 0.6	1.4 ± 0.3	10.5 ± 1.4	0.4 ± 0	0 ± 0	0.4 ± 0.1	2.3 ± 0.3	0.2 ± 0.1	2.1 ± 0.4	0.6 ± 0.2	0.4 ± 0.1
LBFDGG (n=200)	5 ± 0.2	0.2 ± 0	0 ± 0	3.2 ± 0.3	30.4 ± 2.2	34.1 ± 1.6	0.8 ± 0.1	5 ± 0.5	1.6 ± 0.2	0.3 ± 0	0.9 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	2.4 ± 0.2	1.4 ± 0.2	2 ± 0.3	7 ± 0.8	0.4 ± 0	0 ± 0	0.4 ± 0.1	2 ± 0.2	0.1 ± 0	1.3 ± 0.3	0.3 ± 0	0.1 ± 0
LBFGKN (n=182)	4.8 ± 0.2	0.2 ± 0	0 ± 0	3.6 ± 0.4	28.3 ± 1.9	34.6 ± 1.6	0.7 ± 0.2	4.7 ± 0.5	1.8 ± 0.4	0.3 ± 0.2	0.9 ± 0.1	0.7 ± 0	0.2 ± 0.1	0.1 ± 0	2.4 ± 0.3	1.3 ± 0.2	2.4 ± 0.3	7.9 ± 0.9	0.4 ± 0	0 ± 0	0.4 ± 0.1	2 ± 0.2	0.1 ± 0.1	1.6 ± 0.3	0.3 ± 0.1	0.2 ± 0.1
LBFIHE (n=157)	4.9 ± 0.3	0.2 ± 0	0 ± 0	3.7 ± 0.6	25.9 ± 1.9	32.9 ± 1.8	0.8 ± 0.1	4.7 ± 0.6	2.4 ± 0.7	0.3 ± 0.1	0.8 ± 0.1	0.7 ± 0	0.2 ± 0.1	0.1 ± 0.1	2.7 ± 0.3	1.7 ± 0.3	2.5 ± 0.4	9.6 ± 1.3	0.4 ± 0	0 ± 0	0.4 ± 0.1	2.2 ± 0.3	0.2 ± 0.1	2 ± 0.5	0.3 ± 0.1	0.3 ± 0.1
LBFLDI (n=229)	5.9 ± 1	0.3 ± 0.1	0 ± 0.1	2.9 ± 0.3	27.8 ± 2.5	32.5 ± 1.8	0.7 ± 0.1	4.7 ± 0.5	1.7 ± 0.3	0.4 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.1 ± 0	0.1 ± 0	2.4 ± 0.3	1.4 ± 0.2	2.4 ± 0.4	9.2 ± 1.5	0.3 ± 0	0 ± 0	0.5 ± 0.1	2.6 ± 0.4	0.1 ± 0	1.7 ± 0.4	0.3 ± 0.1	0.2 ± 0
LBFPRA (n=196)	5 ± 0.2	0.2 ± 0	0 ± 0	3.9 ± 0.7	23.2 ± 2	30.9 ± 1.9	1.1 ± 0.2	3.8 ± 0.6	2.6 ± 0.5	0.3 ± 0.1	0.9 ± 0.1	0.6 ± 0	0.1 ± 0	0.1 ± 0	3 ± 0.4	1.7 ± 0.2	3.5 ± 0.4	13.5 ± 2	0.4 ± 0	0 ± 0	0.3 ± 0.1	2.6 ± 0.3	0.1 ± 0.1	1.7 ± 0.3	0.1 ± 0	0.3 ± 0.1
LBFDHG (n=177)	5.7 ± 0.2	0.3 ± 0	0 ± 0	3.2 ± 0.5	24.1 ± 0.8	34.5 ± 1.4	0.8 ± 0.1	4.4 ± 0.3	2.5 ± 0.5	0.3 ± 0.1	0.9 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	3.1 ± 0.6	1.9 ± 0.4	1.5 ± 0.3	8.5 ± 1.2	0.4 ± 0	0 ± 0	0.8 ± 0.1	2.5 ± 0.3	0.2 ± 0.1	2.4 ± 0.3	0.8 ± 0.2	0.2 ± 0.1
LBFLFK (n=195)	5 ± 0.1	0.2 ± 0	0.1 ± 0.1	4 ± 0.4	25.9 ± 1.8	31.9 ± 1.3	1 ± 0.2	4.7 ± 0.4	1.8 ± 0.3	0.4 ± 0.1	1 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	4 ± 0.9	2.4 ± 0.5	1.4 ± 0.3	8.3 ± 1	0.4 ± 0	0 ± 0	0.6 ± 0.1	2.7 ± 0.5	0.2 ± 0	1.5 ± 0.4	0.8 ± 0.3	0.3 ± 0.1

Table 150: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed batches having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDAU (n=1)	5.1	0.3	0.0	4.7	20.6	27.6	1.1	4.3	2.5	0.5	1.3	0.6	0.2	0.1	4.0	2.8	1.6	14.1	0.5	0.0	0.4	2.8	0.3	3.5	0.5	0.3
LBFDGG (n=1)	5.2	0.3	0.0	2.9	25.6	33.8	0.7	5.2	2.0	0.4	0.8	0.7	0.2	0.1	2.5	1.6	2.9	9.1	0.4	0.0	0.5	2.4	0.2	2.2	0.3	0.1
LBFGKN (n=1)	4.8	0.2	0.0	3.7	26.5	30.2	1.2	4.9	2.3	0.3	0.8	0.6	0.2	0.1	2.5	1.4	3.2	10.9	0.3	0.0	0.4	2.4	0.1	2.5	0.2	0.3
LBFIHE (n=1)	4.4	0.1	0.0	3.0	20.2	29.0	0.8	4.7	2.8	0.5	0.7	0.7	0.4	0.3	2.9	2.1	3.3	15.3	0.3	0.0	0.5	2.9	0.4	3.9	0.2	0.5
LBFLDI (n=1)	6.7	0.3	0.0	3.0	22.2	28.3	1.1	4.0	2.7	0.7	0.8	0.5	0.1	0.1	3.2	2.1	2.5	13.8	0.4	0.0	0.5	3.4	0.3	2.7	0.5	0.2
LBFPRA (n=1)	5.0	0.2	0.0	3.5	20.0	27.6	1.4	3.1	3.4	0.4	0.8	0.6	0.1	0.1	2.9	1.9	3.8	19.0	0.3	0.0	0.3	2.7	0.1	2.4	0.1	0.4
LBFDHG (n=1)	6.0	0.3	0.0	2.6	23.3	29.4	1.1	5.0	2.3	0.4	0.8	0.7	0.1	0.1	2.8	1.9	1.6	12.8	0.4	0.0	0.7	3.3	0.4	3.3	0.6	0.3
LBFLFK (n=1)	4.9	0.2	0.2	3.8	23.0	31.9	1.0	4.4	2.3	0.5	0.9	0.7	0.1	0.1	3.2	2.1	2.0	11.6	0.3	0.0	0.7	3.0	0.2	2.3	0.5	0.3

Table 151: Phenotypic rating of T2 plants cultivated in the greenhouse of canola events containing the T-DNAs of plasmids VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T2 plants that where rated per event. DFF: days to first flower (days), DF: deformed flower (1=deformed, 9=normal), DL: deformed leaf (1=deformed, 9=normal), DP: deformed plant (1=deformed, 9=normal), DS: deformed silique (1=deformed, 9=normal), FC: flower color (1=white, 3=optimal, 4=orange/yellow), LD: leaf dentation (3=no dentation, 7=strong dentation), LGC: leaf color (3=yellow, 5=optimal, 7=blueish), LF: fertility (1=low, 9=very high), Nol: number of lobes (#), PH: plant height (cm), TKW: thousand kernel weight (g), SC: seed quality (1=good, 9=bad), Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil)

Event	DFF	DF	DL	DP	DS	FC	LD	LGC	LF	NoL	PH	TKW	SC	Oil	Protein
LBFDAU (n=218)	43.2 ± 2.9	9 ± 0	9 ± 0	8 ± 0	9 ± 0	3 ± 0	4 ± 0.1	5 ± 0	8.6 ± 0.8	5.1 ± 0.6	107.5 ± 7.6	3 ± 0.3	3.7 ± 1.2	35.6	
LBFDGG (n=200)	43 ± 3.7	8.6 ± 1.5	8.5 ± 0.5	8 ± 0	8.6 ± 1.3	3 ± 0	4 ± 0	5 ± 0	8.7 ± 0.7	4.5 ± 0.5	112.1 ± 5.5	3 ± 0.3	3.7 ± 0.7	N/A	
LBFGKN (n=182)	42.5 ± 4.3	8 ± 2.7	8.5 ± 1	7.6 ± 1.6	8.1 ± 1.9	2.9 ± 0.3	4.1 ± 0.8	5 ± 0.3	8.5 ± 1	5 ± 0	111.6 ± 15.2	3.3 ± 0.4	3.3 ± 0.6	36.1	
LBFIHE (n=157)	51.1 ± 5.2	8.9 ± 0.4	8.9 ± 0.5	8.9 ± 0.5	5.2 ± 2.6	3 ± 0	5.1 ± 0.4	4.9 ± 0.4	5.2 ± 2.6	6.6 ± 1.1	139.4 ± 14.7	4 ± 0.5	3.8 ± 1.9	34.1	
LBFLDI (n=229)	48.6 ± 4.5	9 ± 0	9 ± 0	9 ± 0	7.6 ± 2.5	3 ± 0	5 ± 0.1	5 ± 0.1	7.6 ± 2.5	6.2 ± 1.1	145.5 ± 15.9	4.2 ± 0.4	3.1 ± 1.3	N/A	
LBFPRA (n=196)	51.2 ± 2.4	9 ± 0	9 ± 0	9 ± 0	5.8 ± 3.2	3 ± 0	5 ± 0	5 ± 0	5.8 ± 3.2	7.3 ± 1	138.7 ± 16.6	4.2 ± 0.4	2.4 ± 1.5	34.7	
LBFDHG (n=177)	46 ± 3.5	9 ± 0	9 ± 0	8 ± 0	4.7 ± 1.6	3 ± 0	4 ± 0	5 ± 0	8.5 ± 0.8	5.2 ± 0.8	112.5 ± 5.4	3.4 ± 0.4	5.3 ± 1	32.3	
LBFLFK (n=195)	42.3 ± 2.8	9 ± 0	9 ± 0	9 ± 0.3	8.9 ± 0.7	3 ± 0	4 ± 0.1	5 ± 0	8.7 ± 0.9	5.3 ± 0.5	113.4 ± 8	3.3 ± 0.3	3.9 ± 1.5	37.1	

Fatty acid profiles, copy number measurements, and phenotypic observations of T2 plants carrying T-DNAs of plasmids VC-LTM593-1qcz rc cultivated in field trials in USDA growth zones 3a-4b and 5a during the summer

Field data for the T3 seed from the events carrying the T-DNA from VC-LTM593-1qcz rc, shown in Table 152 and Table 153, indicate that the plants are capable of making VLC-PUFAs in the field (ARA, EPA and DHA), though not at the level observed in the greenhouse. ANOVA was conducted with using the software JMP 11.0. Analysis was conducted at the 95% confidence level using Tukey test. To compensate for unbalance in the data obtained from the field trial (e.g. due to e.g. weather), Least Square menas instead of means where used in the statistical analysis. Common letters in the Table 154, Table 155and Table 156 indidcate no significant difference of the least square means. Table 154 shows the statistical analysis of agronomical parameters.

There was a difference in seed oil content observed compared to the greenhouse (e.g. comparing Table 154 with Table 151), indicating oil content and the fatty acid profile could be linked. These observations are in agreement with previous examples (Examples 10, 11, and 13) where it was observed that increased oil contents in the field grown plants concomitant with a decrease in VLC-PUFAs, in particular EPA, DHA and ARA. A more detailed description of the observations regarding oil content and VLC-PUFAs is given in Example 20.

The % of EPA and DHA (% (w/w) for each fatty acid compared to the total weight of fatty acids) in Table 152 can be combined with the oil amount in Table 154 to calculate the mg EPA+DHA /g seed produced in the transgenic events. Using this calculation, bulked seeds from event LBFGKN were determined to have 25.7 mg EPA+DHA/g seed and bulked seeds from event LBFDAU was determined to have 47.4 mg EPA+DHA/g seed.

For seed yield (kg per ha, Figure 88), no statisticaly relevant difference was found comparing the events against wildtype Kumily when grown in the field with or without treatment with imidazolinone herbicide (tested using Tukey, 0.05% level). Thus, in one embodiment, the present invention relates to one or more transgenic plants, preferably B. napus plant(s), producing EPA and DHA, according to the present invention whereby the seed yield of the plant is 80%, 85%, 90%, 95%, 96%, 97%, 98%, 99% or more identical to a control plant. Preferably, the seed yield of the plant is 80%, 85%, 90%, 95%, 96%, 97%, 98%, 99% or more identical to a control grown without treatment with imidazolinone herbicide whereas the plant of the invention is grown with an imidazoline herbicide treatment.

In one embodiment, the harvesting bulk seed from the plants of the invention, preferably from the plants grown in a field, has a measured yield (kg seed/ha) that is 15%, 8%, 4%, or preferably 1% or less lower than the yield of a control plant. Preferably, the harvested bulk seed yield of the plant is 80%, 85%, 90%, 95%, 96%, 97%, 98%, 99% or more identical to a control grown without treatment with imidazolinone herbicide whereas the plant of the invention is grown with an imidazoline herbicide treatment.

Thus, a transgenic B. napus plant of the invention is able to produce more than 1% EPH + DHA in the oil in the bulk seed, preferably, it produces more than 2%, e.g. more than 3%, 4%, 5%, 6%, 7%, 8%, 9% or more than 10% oil in the bulk seed. Preferably, the oil in the bulk seed of the plant of the invention is 80%, 85%, 90%, 95%, 96%, 97%, 98%, 99% or more identical to a control plant grown without treatment with imidazolinone herbicide whereas the plant of the invention is grown with an imidazoline herbicide treatment. The contents are expressed as percentage (weight of EPA + DHA) of the total weight of all fatty acids (present in the oil or lipid). The contents are thus, preferably given as weight percentage (% (w/w)).

A control plant is preferably a plant that is at least genetically 90%, 95%, 96%, 97%, 98%, or preferably 99% or 99,5% or more identical to the plant of the invention, e.g. to the plants described in the examples, but does not produce any VLC-PUFA grown under the same conditions, e.g. a wild type grown under the same conditions.

Herbicide treatment also did not have a consistent effect on EPA and DHA (Figure 89), oil (Figure 90), or protein (Figure 91) content in seeds compared to plants that were not sprayed with imidazolinone. Thus, in one embodiment, the present invention relates to one or more transgenic plants, preferably B. napus plant(s), producing EPA and DHA, according to the present invention whereby the oil (Figure 90), or protein (Figure 91) content of the plant is 80%, 85%, 90%, 95%, 96%, 97%, 98%, 99% or more identical to a control plant.

A control plant is preferably a plant that is at least genetically 90%, 95%, 96%, 97%, 98%, or preferably 99% or 99,5% or more identical to the plant of the invention, e.g. to the plants described in the examples, but does not produce any VLC-PUFA, in particular a control plant grown without treatment with imidazolinone herbicide whereas the plant of the invention is grown with a imidazoline herbicide treatment.

Thus, in one embodiment, the bulk seed of the transgenic plant of the invention comprises a seed oil that contains EPA and DHA, wherein the the content of EPA and DHA in the seed oil is more than 2%, 3, %, 4%, 5%, 5.9%, 6%, 7%, 8%, 9%, 10%, 12%, 15% of the total fatty acid content in seed oil, even after treatment with imidazolinone herbicide

Fertility of plants in the field was assessed by rating the percent of sterile pods on mulitple plants from each plot. Fertility was assessed for WT Kumily, and for events LBFDGG, LBFGKN, LBFIDT, LBFIHE, LBFLDI, and LBFPRA. On a scale of 0 to 10, a score of 0 means that 0% of pods were sterile, 1 means that 10% of pods were sterile, 2 means that 20% of pods were sterile, and so on up to 10, which means that 100% of pods were sterile. The mean fertility score for wild type Kumily control plants across all plots was 0.17, meaning that 1.7% of pods were sterile. The mean score for the transgenic events ranged from 0.33 to 0.63, meaning that 3.3 to 5.3% of pods were sterile.

Interestingly, expression of the polynucleotides encoding the desaturases or elongases as referred to herein did not significantly affect the fertility of the generated plants. As compared to control plants (wild-type plants), the fertility was only slighty decreased.

Thus, the present invention relates in one embodiment to a a transgenic plant, preferably to a transgenic B. napus plant seed containing more than 2%, 2,5%, 3%, 4%, 5%, 6%, 7%, 8%; 9%, 10%, 12% or more EPA and DHA in the seed oil when grown in field conditions. The average plant fertility as measured by selecting at random a number of plants then observing percent plants with one or more sterile pods/bud is 30% or less, or is 20% or less, or is about 10% or less or is 5% or less or is 4% or less or is 3,3% or less, preferably is between 1% and 10%, more preferred between 3% and 7%, e.g. between 3.3% and 5.3% of the same measure observed in a control plant, e.g. in a wild type plant grown under the same conditions.

Preferably, a control plant is preferably a plant that at least genetically 90%, 95%, 96%, 97%, 98%, or preferably 99% or 99,5% or more identical to the plant of the invention, e.g. to the plants described in the examples, but does not produce any VLC-PUFA.

In one embodiment, the plant of the invention was transformed with a medium (>10,000 base pairs) or large (>30,000 base pairs) T-DNA insert, e.g. a T-DNA described in the Examples. In one embodiment, the T-DNA is consists of 1000bps to 10,000 bps, e.g. between 3000bps and 9000bps, preferably between 4000bps and 8500bps.

Table 152: Fatty acid profiles of T3 seeds harvested from T2 plants cultivated in the field, corresponding to USDA growth zones 3a-4b and 5a, for field trials of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of T3 seed aliquots representing a plot where measured per event. For event LBFGKN, 36 plots and 60 single plants from those plots where measured. Per seed batch a random selection of ~15 seed was measured in five technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDAU (n=16)	4.7 ± 0.1	0.2 ± 0	0 ± 0	2.7 ± 0.1	28.6 ± 1.5	29.2 ± 0.7	1 ± 0.1	6.1 ± 0.3	1.6 ± 0.1	0.3 ± 0	0.7 ± 0	0.7 ± 0	0.1 ± 0	0.1 ± 0	3.3 ± 0.3	2.2 ± 0.2	2 ± 0.2	10.7 ± 0.7	0.3 ± 0	0 ± 0	0.3 ± 0	2.9 ± 0.2	0.1 ± 0	1.6 ± 0.2	0.3 ± 0.1	0.3 ± 0
LBFDGG (n=36)	4.7 ± 0.1	0.2 ± 0	0 ± 0	2.5 ± 0.2	34.2 ± 1.9	32.3 ± 1.2	0.6 ± 0.1	7 ± 0.5	1.2 ± 0.1	0.2 ± 0	0.6 ± 0	0.8 ± 0	0.1 ± 0	0.1 ± 0	2 ± 0.3	1.3 ± 0.2	1.9 ± 0.2	6.1 ± 0.7	0.3 ± 0	0 ± 0	0.3 ± 0	2.1 ± 0.2	0.1 ± 0	1.1 ± 0.2	0.2 ± 0.1	0.1 ± 0
LBFGKN (n=36+60)	4.6 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.2	33.7 ± 1.7	32.8 ± 1.4	0.6 ± 0.1	7.5 ± 0.6	0.9 ± 0.1	0.2 ± 0	0.7 ± 0	0.8 ± 0.1	0.2 ± 0	0.1 ± 0	2.1 ± 0.3	1.2 ± 0.1	1.8 ± 0.2	6 ± 0.6	0.3 ± 0	0 ± 0	0.3 ± 0.1	2.1 ± 0.2	0.1 ± 0	1 ± 0.1	0.2 ± 0	0.2 ± 0
LBFIHE (n=36)	4.8 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.2	31.2 ± 1.7	33.9 ± 1.2	0.6 ± 0.1	6.7 ± 0.7	1.3 ± 0.2	0.3 ± 0	0.7 ± 0.1	0.8 ± 0	0.2 ± 0	0.1 ± 0	2.1 ± 0.2	1.2 ± 0.1	2.4 ± 0.3	6.7 ± 0.6	0.3 ± 0	0 ± 0	0.3 ± 0.1	1.9 ± 0.2	0.1 ± 0	1.2 ± 0.2	0.2 ± 0.1	0.2 ± 0
LBFLDI (n=36)	4.9 ± 0.2	0.3 ± 0	0 ± 0	2.5 ± 0.2	33.4 ± 1.7	32.7 ± 1.2	0.6 ± 0.1	6.8 ± 0.6	1 ± 0.1	0.2 ± 0	0.7 ± 0.1	0.8 ± 0	0.2 ± 0	0.1 ± 0	2 ± 0.3	1.2 ± 0.2	2 ± 0.2	6.2 ± 0.7	0.3 ± 0	0 ± 0	0.3 ± 0	2.1 ± 0.2	0.1 ± 0	1.1 ± 0.2	0.2 ± 0	0.2 ± 0
LBFIDT (n=32)	4.6 ± 0.1	0.2 ± 0	0 ± 0	2.7 ± 0.2	30 ± 1.4	29.9 ± 1	0.9 ± 0.1	6.5 ± 0.5	1.6 ± 0.1	0.3 ± 0	0.7 ± 0.1	0.7 ± 0	0.1 ± 0	0.1 ± 0	4.4 ± 0.4	2.6 ± 0.2	1.5 ± 0.2	6.8 ± 0.7	0.3 ± 0	0 ± 0	0.6 ± 0.1	2.9 ± 0.3	0.1 ± 0	1.2 ± 0.2	1 ± 0.1	0.3 ± 0
LBFPRA (n=36)	4.8 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.2	28.4 ± 2.1	32.7 ± 1.4	0.8 ± 0.1	5.7 ± 0.4	1.6 ± 0.2	0.3 ± 0.1	0.7 ± 0	0.8 ± 0	0.2 ± 0	0.1 ± 0	2.3 ± 0.3	1.2 ± 0.2	3.8 ± 0.5	9.6 ± 1	0.3 ± 0	0 ± 0	0.3 ± 0	2.4 ± 0.3	0.1 ± 0	1.1 ± 0.2	0.1 ± 0	0.2 ± 0.1
LBFDHG (n=4)	5.2 ± 0.1	0.2 ± 0	0 ± 0	2.4 ± 0.1	28.2 ± 1.4	29.5 ± 1	0.9 ± 0.2	6.5 ± 0	1.6 ± 0.1	0.3 ± 0	0.6 ± 0	0.7 ± 0	0.2 ± 0	0.1 ± 0	2.9 ± 0	1.7 ± 0	2 ± 0.1	9.6 ± 0.4	0.3 ± 0	0 ± 0	0.6 ± 0	3.5 ± 0.1	0.2 ± 0	1.9 ± 0.2	0.5 ± 0.1	0.3 ± 0
LBFLFK (n=36)	4.7 ± 0.2	0.2 ± 0	0 ± 0	2.6 ± 0.2	30.1 ± 1.9	30.2 ± 1.1	0.9 ± 0.1	6.2 ± 0.4	1.5 ± 0.2	0.3 ± 0.1	0.6 ± 0	0.8 ± 0	0.1 ± 0	0.1 ± 0	3.3 ± 0.3	1.9 ± 0.2	1.9 ± 0.2	8.2 ± 1	0.3 ± 0	0 ± 0	0.5 ± 0	3.2 ± 0.4	0.1 ± 0	1.4 ± 0.3	0.5 ± 0.1	0.3 ± 0.1

Table 153: Fatty acid profiles of one T3 seed batch per event harvested from T2 plants cultivated in USDA growth zones 3a-4b and 5a for field trials of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. The events are indicated in the first column. Fatty acid profiles of T3 seed

batches representing a field plot having the highest EPA+DHA levels per event are shown. Per seed batch, a random selection of ~30 seed was measured in two technical repeats.

Event	16:0	16:1 n-7	16:3 n-3	18:0	18:1 n-9	18:2 n-6	18:2 n-9	18:3 n-3	18:3 n-6	18:4 n-3	20:0	20:1 n-9	20:2 n-6	20:3 n-3	20:3 n-6	20:4 n-3	20:4 n-6	20:5 n-3	22:0	22:1 n-9	22:4 n-6	22:5 n-3	22:5 n-6	22:6 n-3	22:4 n-3	20:2 n-9
LBFDAU (n=1)	4.9	0.2	0.0	2.6	26.0	28.9	0.8	6.2	1.7	0.3	0.7	0.8	0.2	0.1	3.6	2.4	2.0	12.0	0.3	0.0	0.3	3.2	0.1	2.1	0.4	0.3
LBFDGG (n=1)	5.0	0.3	0.0	2.7	30.1	33.1	0.5	6.5	1.5	0.3	0.7	0.8	0.2	0.1	2.1	1.4	2.4	7.5	0.3	0.0	0.4	2.4	0.1	1.6	0.2	0.1
LBFGKN (n=1)	4.4	0.2	0.0	2.6	32.6	31.1	0.7	7.3	1.1	0.3	0.6	0.8	0.2	0.1	2.1	1.3	2.1	7.7	0.3	0.0	0.3	2.5	0.1	1.3	0.2	0.2
LBFIHE (n=1)	4.8	0.2	0.0	2.5	28.0	33.9	0.6	6.3	1.6	0.3	0.8	0.8	0.2	0.1	2.4	1.5	2.7	8.2	0.3	0.0	0.4	2.3	0.1	1.6	0.2	0.2
LBFLDI (n=1)	5.2	0.3	0.0	2.5	29.8	33.3	0.4	6.8	1.3	0.4	1.1	0.8	0.2	0.1	1.8	1.2	2.4	7.2	0.4	0.0	0.4	2.4	0.1	1.6	0.2	0.2
LBFIDT (n=1)	4.7	0.2	0.0	2.6	28.6	28.8	1.0	7.1	1.6	0.3	0.7	0.7	0.1	0.1	4.3	2.6	1.5	8.1	0.3	0.0	0.6	3.4	0.1	1.4	1.0	0.4
LBFPRA (n=1)	5.1	0.2	0.0	2.6	26.0	31.5	0.7	5.3	1.8	0.3	0.7	0.7	0.2	0.1	2.4	1.3	4.3	11.7	0.3	0.0	0.3	2.8	0.0	1.3	0.1	0.2
LBFDHG (n=1)	5.1	0.2	0.0	2.4	29.0	28.4	1.0	6.6	1.6	0.3	0.6	0.8	0.1	0.1	2.9	1.7	1.9	10.2	0.3	0.0	0.5	3.5	0.2	1.9	0.5	0.3
LBFLFK (n=1)	5.1	0.2	0.0	2.6	26.9	29.3	0.8	5.9	1.9	0.4	0.7	0.8	0.1	0.1	3.1	2.0	2.3	10.3	0.3	0.0	0.6	3.9	0.1	2.0	0.5	0.2

Table 154: Phenotypic rating of T2 plants cultivated in USDA growth zones 3a-4b and 5a for field trials of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. The events are indicated in the first column, along with the number of field plots that where rated per event. Stand: the number of plants that emerged within a 1 meter section of row at GS 14 (4 leaves unfolded), rating of a seedlings ability to grow and develop at GS 14 (4 leaves unfolded, 1= All plants at different growth stages and all plants appear unhealthy, 9= All plants at same growth stage and all plants appear healthy), Plant Height: the average height (cm) of five plants in a plot measured from soil level to the top of the plant at GS 69 (cm), Lodging: rating of the average standability of plants in a plot at GS 83 (30% of pods ripe, 1=0 – 10% average lean of plants in plot from horizontal (standing erect), 9=81%+ average lean of plants in plot from horizontal (nearly prostrate)), Shatter: rating of the ability of plants to retain seed in the pod at GS 89 (all pods fully ripe, 1=0 – 10% perished pods, 9=81%+ perished pods), Agron Score: scale of 1-5 with 1 being the best, 5 the worst ranking of plant phenotype (measurements occurred post flower during pods formation and seed development),Moisture (% of seed weight), TKW: thousand kernel weight (g), Oil: oil content (% of seed weight), protein: Protein content (% of seed cake without oil).

Event	Stand		Vigor								Plant Height		Lodging		Shatter		Agron Score		Moisture		TWK		Oil		Protein	
LBFDAU (n=16)	23.7	a	5.7	bcd							115.5	b	2.3	ab	1.5	a	4.7	ab	9.0	a	3.5	abcd	38.5	bc	26.6	c
LBFDGG (n=36)	23.0	a	5.9	bcd							116.2	b	2.3	b	1.6	a	4.2	ab	8.9	a	3.8	a	38.8	abc	26.3	c
LBFDHG (n=4)	23.4		5.8								115.9		2.3		1.5		4.4		9.0		3.7		39.3	abc	26.5	c
LBFGKN (n=36)	22.8	a	6.3	bcd							118.8	b	2.8	ab	1.8	a	4.1	ab	8.5	a	3.7	ab	36.7	c	26.5	c
LBFIHE (n=36)	21.7	a	5.6	cd							115.2	b	2.3	b	1.6	a	4.1	ab	8.7	a	3.4	bcd	39.8	ab	26.5	c
LBFLFK (n=36)	22.5	a	5.1	d							118.4	b	2.6	ab	1.5	a	4.1	ab	8.6	a	3.7	a	38.3	bc	27.1	c
LBFPRA (n=36)	22.5	a	6.3	bcd							121.2	b	2.9	ab	1.9	a	4.2	ab	8.5	a	3.5	abc	39.2	abc	26.5	c
Topas	24.8	a	5.2	d							139.7	a	3.2	ab	2.6	a	4.4	a	7.3	b	3.3	cd	37.8	c	26.9	c
Kumily	28.2	a	6.9	ab							119.9	b	2.8	ab	1.8	a	4.5	a	7.4	b	3.7	ab	39.8	ab	28.5	a

Event	Stand		Vigor								Plant Height		Lodging		Shatter		Agron Score		Moisture		TWK		Oil		Protein	
Control 1	28.1	a	7.7	a							121.1	b	3.9	a	2.7	a	3.4	b	7.0	b	3.2	d	39.9	ab	27.1	c
Control 2	25.3	a	6.6	abc							119.1	b	3.8	a	2.7	a	3.4	b	7.0	b	3.1	d	40.7	a	27.4	bc

Table 155: Compositional analysis of T3 seeds of T2 plants cultivated in USDA growth zones 3a-4b and 5a for field trials of canola events containing the T-DNAs of plasmid VC-LTM593-1qcz rc. The events are indicated in the first column. The analysis has been done on 4 BULK, whereby each BULK is a representative sample of all seeds harvedted from 4 different geographic reagions. Alpha-Tocopherol (mg/100g seed), Beta-Tocopherol (mg/100g seed), Delta-Tocopherol (mg/100g seed), Gamma-Tocopherol (mg/100g seed), Tocopherol (mg/100g seed), Sinapine (µg/g (ppm)), Phytate (% of seed weight (w/w)), Ash (% of seed weight (w/w)), Crude Fiber (% of seed weight (w/w)), ADF: acid detergent fiber (% of seed weight (w/w)), NDF: neutral detergent fiber (% of seed weight (w/w)). All results have been normalized to the seed weight of seeds having 0% moisture.

Event	Alpha-Tocopherol		Beta-Tocopherol		Delta-Tocopherol		Gamma-Tocopherol		Tocopherols (VitE)		Sinapine		Glucosinolate		Phytate		Ash		Crude Fiber		ADF		NDF	
LBFDAU	13.3	ab	0.25	a	0.58	a	29.5	a	43.7	a	0.64	cd	11.0	bcd	2.3	B	4.5	ab	9.4	a	11.8	ab	14.5	a
LBFDGG	14.1	ab	0.23	a	0.45	bcd	25.6	b	40.4	abc	0.69	bcd	13.1	ab	2.3	B	4.3	ab	9.2	a	10.9	cdef	13.6	ab
LBFGKN	12.9	b	0.23	a	0.52	abc	26.9	ab	40.6	abc	0.70	bc	11.3	bc	2.3	b	4.4	ab	9.3	a	11.0	bcdef	13.5	ab
LBFIHE	13.2	ab	0.23	a	0.45	bcd	22.0	cd	35.9	cde	0.65	cd	15.7	a	2.2	b	4.7	ab	9.1	a	10.8	cdef	13.4	ab
LBFLFK	12.5	b	0.23	a	0.52	abc	25.7	b	38.9	abc	0.68	bcd	12.6	abc	2.3	b	4.3	b	9.6	a	11.3	abcde	13.7	ab
LBFPRA	13.6	ab	0.22	a	0.47	bcd	24.9	bc	39.2	abc	0.62	d	10.9	bcd	2.2	b	4.3	ab	9.6	a	12.0	a	14.6	a
Topas	14.7	ab	0.25	a	0.36	d	16.6	e	31.9	e	0.69	bcd	7.6	d	2.7	a	4.8	a	9.0	a	10.5	ef	12.9	b
Kumily	12.3	b	0.23	a	0.54	ab	24.4	bc	37.5	bcd	0.78	a	11.0	bcd	2.2	b	4.3	b	9.1	a	11.5	abc	14.3	a
Control 1	16.6	a	0.25	a	0.43	cd	24.1	bc	41.4	ab	0.73	ab	9.5	cd	2.3	b	4.6	ab	8.6	a	10.2	f	12.8	b
Control 2	12.0	b	0.20	a	0.45	bcd	20.8	d	33.5	de	0.72	ab	11.9	bc	2.3	b	4.4	ab	9.2	a	10.6	def	13.8	ab

Table 156: Herbicde tolerance of T2 plants cultivated in USDA growth zones 3a-4b and 5a for field trials of canola events containing the T-DNAs of plasmid VC- VC-LTM593-1qcz rc. The events are indicated in the first column. **IMI Injury**: injury according to the scale detailed in Table 157 (DAT= days after treatment). Herbicide imazamox was aplied at a 2x rate of 70 g imazamox /ha. Brassica napus cv Kumily, which is the non-transgeneic comparator line that is otherwise isogenic to the events, was rated at 6 to 7, and was removed from the statistical analysis to make the Tukey test more sensitive to detect significant differences between events that are very similar in their tolerance.

Event	IMI Injury 7 DAT		IMI Injury 14 DAT		IMI Injury 21 DAT	
LBFDAU	2	a	1	ab	1	a
LBFDGG	2	a	1	ab	1	a
LBFDHG	2		1		1	
LBFGKN	2	a	1	ab	1	a
LBFIHE	2	a	2	a	1	a
LBFLFK	2	a	1	b	1	a
LBFPRA	2	a	1	ab	1	a
Topas	1	a	1	b	1	a
Kumily	6		6		7	

Table 157: Canola rating scale for herbicide

% Injury	1-7 Scale	Category	Injury Symptoms	Growth Rates and Recovery Effects
0	**1**	Excellent	None	None
1-6	**2**	Very Good	Leaf and petiole epinasty, chlorosis.	Minor or temporary growth effects. Injury and effects should be minor enough to not cause commercialization concerns.
7-14	**3**	Good	Leaf, petiole and stem epinasty, chlorosis, stem swelling. Leaf cupping may be observed.	This would be the maximum allowable injury for commercial evaluations. Fairly temporary in nature without any effect on final yield and minimal delay in maturity,
15-20	**4**	Fair	Above symptoms plus stunting in height, smaller leaf size or impact on LAI, in this class: Basal swelling may be observed. Expect recovery and seed production with this set of symptoms but delayed, reduced growth and reduced seed set. Plant stand may be non-uniform upon recovery.	Appearance of unaffected new growth impeded for <7 days. Slight delay in bolting and flower production. Yield impact minimal or small at harvest.
21-40	**5**	Poor	Injury in this class would be as above and more than evaluator's estimate of the level of commercial acceptance.	Significant delay in plant development, significant malformation s in growth and development vs. control. Malformations persist Serious reduction in maturity, height and harvest yield.
41-79	**6**	Non Tolerant		Equivalent to suppression as a volunteer crop in a weed control assessment. Minimal regrowth following application. Plants survive but fail to flower and mature as normal.
80-100	**7**	Susceptible	Severe injury or death.	Severe injury or death.

Example 19: Gene copy number effects on observed conversion efficiencies at each pathway step.

When analysing the VLC-PUFA levels of the various constructs listed in this invention, distinct differences were observed in conversion efficiency at the pathway steps when the T-DNA copy number increased. This was observed when comparing the VLC-PUFA levels of (1) events having a single copy T-DNA insertion vs a double copy T-DNA insertion, (2) heterozygous plants vs homozygous plants, and (3) when analysing segregating single seeds as described in Example 9 and shown in Figure 22 and Figure 23. This demonstrates a relationship between ‘gene dosage’, that is the number of T-DNA copies present in the genome, and VLC-PUFA levels. Upon further investigation it is clear that certain genes/steps of the VLC-PUFA pathway benefit more in terms of impact on the pathway when the gene number and/or expression level of the gene or activity at that step is increased. While the contribution from each gene present, when multiple genes which encode enzymes with identical activities are present, are difficult to assess (e.g. two different omega-3-desaturases are technically difficult to assess), it was possible to calculate conversion efficiencies for each pathway step, by using the equations shown in Figure 2. These conversion efficiencies for each pathway step were calculated for various populations of plants that represent a certain gene dosage, in order to investigate if the observed increase in conversion efficiency can be assigned to one or more individual pathway steps (e.g. increasing conversion efficiency due to increased gene dosage at one early step in the pathway may increase conversion efficiency at a later step simply be providing more of a limiting substrate).
The conversion efficiencies are sometimes referred to as “apparent” conversion efficiencies because for some of the calculations it is recognized that the calculations do not take into account all factors that could be influencing the reaction. As an example of factors that may be influencing a reaction but are not taken into account during the conversion efficiency calculation; the substrates of the delta-6-desaturase are produced while bound at the sn-2 positions of phospholipids, whereas the product of the delta-6-desaturase is formed while the fatty acid is bound to CoA. It is therefore not immediately clear if the lower delta-6-desaturase conversion efficiencies shown in Figure 33 are due to inefficient provision of substrate to the delta-6-desaturase via trans-esterification from PC (phosphatidylcholine) bound LA/ALA to CoA bound LA/ALA, or whether the delta-6-desature had low activity/low conversion efficiency.
For the interpretation of the conversion efficiencies it was also important to note that any catalyzed conversion of substrate to product was dependent on the substrate concentration, catalyst (enzyme) concentration, and product concentration.

Analysing the data pathway step by pathway step, the following observations can be made in Figure 32 to Figure 39:

Conversion efficiency of delta-12-desaturation

The delta-12-desaturase conversion efficiency encompasses all steps that influence substrate concentration, product concentration, and enzyme concentrations. From the data in example 21 it is evident that the delta-12-desaturase, c-d12Des(Ps_GA), enzymatically produces phosphatidylcholine bound 18:2n-6 (Figure 26, Panel A), which implies the substrate was phosphatidylcholine bound 18:1n-9. The primary flux of newly formed 18:1n-9 was derived from plastid produced 18:1n-9, which was exported into the cytosol, where it was bound to CoA. Therefore, a prerequisite of delta-12-desaturation was the incorporation of CoA-bound 18:1n-9 into the sn2 position of phosphatidylcholine via LPCAT (Lysophosphatidylcholine acetyltransferase EC 2.3.1.23), or via LPAAT (Lysophosphatidic acid acyltransferase E.C. 2.3.1.51), with subsequent conversion of the formed (sn2)18:1n-9-phosphatidic acid into (sn2)18:1n-9-DAG (DAG is an abbreviation for diacylglycerol), whereby (sn2)18:1n-9-DAG was either directly converted into (sn2)18:1n-9-PC (PC is an abbreviation for phosphatidylcholine) substrate for the delta-12-desaturases via PDCT (phosphatidylcholine diacylglycerol cholinephosphotransferase EC 2.7.8.2), or obtains a phosphocholine headgroup via CPT (CPT is an abbreviation for sn-1,2-diacylglycerol:cholinephosphotransferase EC 2.7.8.2) to be converted into (sn2)18:1n-9-PC. The efficiency of this incorporation of plastid synthesized 18:1n-9 directly affects delta-12-desaturase substrate concentration. As mentioned already, PC is converted by PDCT into DAG, which was subsequently converted into TAG. The amount of PC bound delta-12-desaturase substrate and product that was part of the delta-12-desaturase reaction was therefore also directly linked to the substrate specificity of PDCT.

There was a strong correlation of the delta-12-desaturation conversion efficiency with the copy number of the delta-12-desaturase (Figure 32). This was evident when comparing the average conversion efficiency of T0 single copy plants (across all events per construct), with the average conversion efficiency of T0 double copy plants (across all events per construct). The same correlation can be seen in the T1 generation. The strong correlation of the delta-12-desaturation conversion efficiency with the copy number of the delta-12-desaturase was also seen when comparing copy number differences due to heterozygous vs homozygous T-DNA integrations: The T0 generation always consist of heterozygous plants, whereas the T1 generation largely consists of homozygous plants due to the selection applied in Example 10 through Example 18. The delta-12-desaturation conversion efficiency increases when comparing the average conversion efficiency of T0 single copy plants (across all events per construct), with the average conversion efficiency of T1 single copy plants (across all events per construct). Similarly, the delta-12-desaturation conversion efficiency increases when comparing the average conversion efficiency of T0 double copy plants (across all events per construct), with the average conversion efficiency of T1 double copy plants (across all events per construct). The only exceptions are:
1) T0 single copy events vs T0 double copy events containing the T-DNAs of VC-LJB2197-1qcz and VC-LLM337-1qcz rc: while not as pronounced as for VC-LJB2197-1qcz and VC-LLM306-1qcz rc, there are also subtle differences here in delta-12-desaturase conversion efficiencies. The slight differences are due to insufficient data in the T0 generation to accurately assign the events to the two copy number categories for events containing the T-DNAs of construct VC-LJB2197-1qcz and VC-LLM337-1qcz rc, and
2) T0 single copy events vs T0 double copy events containing the T-DNAs of VC-LJB2197-1qcz and VC-LLM338-3qcz rc: while not as pronounced as for VC-LJB2197-1qcz and VC-LLM306-1qcz rc, also here the subtle differences in delta-12-desaturase conversion efficiencies are due to insufficient data in the T0 generation to accurately assign the events to the two copy number

categories for events containing the T-DNAs of construct VC-LJB2197-1qcz and VC-LLM338-3qcz rc, and

3) T1 single copy events vs T1 single copy (single locus) events containing the construct VC-LTM593-1qcz rc: there was no effect on the conversion efficiency due to the 2-fold copy number difference between these groups. The group of single copy (single locus) events is affected by an additional phenomenon whereby the average VLC-PUFA level in T2 seeds of T1 plants of this homozygous group decreases instead of increasing compared to segregating T1 seeds of heterozygous T0 plants. A further indication that this group was an outlier group can be seen in Figure 35, where it was evident that the delta-5-desaturase conversion efficiency was significantly lower in homozygous plants compared to heterozygous plants.

Considering the high conversion efficiency of the delta-12-desaturase, it is likely that the provision of substrate via LPCAT is not a bottleneck. Also, the data suggest that efficient removal of delta-12-desaturase products contributes to the high conversion efficiency. However; taking into account the high levels of 18:2n-6 accumulated in the oil and the low delta-6-conversion efficiency, it was evident that not all delta-12-desaturated 18:2n-6 was removed from PC via trans-esterification to CoA (the site of action for the next pathway step). With respect to the fate of 18:2n-6; our observations indicate that the delta-12-desaturated 18:2n-6 was likely removed by the direct conversion of unsaturated PC into DAG via PDCT as discussed by Bates et al. (2012) Plant Physiology 160: 1530-1539. This activity of PDCT strongly supports a high delta-12-desaturase conversion efficiency by providing fresh 18:1n-9-PC substrate to the delta-12-desaturase, while simultaneously removing 18:2n-6-PC product (by conversion into DAG). However, the latter activity poses a strong bottleneck for the continuation of the pathway, which is evident by the low delta-6-desaturase conversion efficiencies.

This effect of increased conversion efficiency of the delta-12-desaturase has been observed when analyzing the PUFA profile of more than 6.000 plants that have been obtained by transforming more than 300 multi-gene constructs into Canloa and Arabidopsis, whereby all of these constructs carried genes having the essential activities required for Arachidonic acid synthesis. Across these more then 300 constructs, more than 10 different delta-12-desaturase enzymes have been investigated.

Conversion efficiency of delta-6-desaturation

For the delta-6-desaturation, it was of particular importance to highlight that conversion efficiencies observed for this step are dependent on the substrate concentration (which was CoA bound linoleic acid), catalyst concentration (which was the delta-6-desaturase), and product concentration. It was, that PC bound 18:2n-6 produced by the delta-12-desaturase needs to be trans-esterified to CoA before delta-6-desaturation can take place. The absence of accumulation of 18:3n-6 and 18:4n-3 in the examples 10 -18 strongly indicates that CoA-bound 18:3n-6 and CoA-bound 18:4n-3 was efficiently converted by the delta-6-elongase, effectively preventing any significant accumulation of 18:3n-6 and 18:4n-3. In general, delta-6-desaturase conversion efficiencies are low for all constructs. Considering efficient removal of product was not a bottleneck, the low conversion efficiencies can be either due to low activity of the delta-6-desaturase enzyme, or because of inefficient conversion of PC-bound substrate into CoA-bound substrate. Regardless of this, there was a clear correlation of the delta-6-desaturation conversion efficiency with the copy number of the delta-6-desaturase. In a manner similar to that of the delta-12-desaturase, this was seen regardless of the reason for the copy number increases (heterozygous vs homozygous, single copy genomic integrations vs double copy genomic integrations). In fact, plants of the construct combination VC-LJB2197-1qcz and VC-LLM306-1qcz rc contain an additional copy of the delta-6-desaturase on the T-DNA. It was therefore consistent that the group of 22 double copy T1 plants would have in the T2 seeds the highest delta-6-desaturase conversion efficiencies of all similar double copy groups of different constructs.

For the delta-6-desaturase, the same exceptions to this copy number effect as for the delta-12-desaturase are seen. The same for the interpretation mentioned for the delta-12-desaturase of why these exceptions are observed are assumed to be the reasons for the delta-6-desaturase also applies in this case. The exceptions are:

1) T0 single copy events vs T0 double copy events containing the T-DNAs of VC-LJB2197-1qcz and VC-LLM306-1qcz rc, and

2) T0 single copy events vs T0 double copy events containing the T-DNAs of VC-LJB2197-1qcz and VC-LLM337-1qcz rc, and

3) T0 single copy events vs T0 double copy events containing the T-DNAs of VC-LJB2197-1qcz and VC-LLM338-3qcz rc, and

4) T1 single copy events vs T1 single copy(single locus) events containing the construct VC-LTM593-1qcz rc.

As demonstrated for the delta-12-desaturase, the amount of delta-12-desaturase product increases with increasing copy number of the delta-12-desaturases, which implies an increased amount of substrate for the delta-6-desaturase. As both the delta-12-desaturases and the delta-6-desaturase are contained on the same T-DNA in all examples 10 to 18, the copy number of the delta-6-desatuases will also increase when copy number of the delta-12-desaturase increases, with the exceptions of events where truncated insertion of the T-DNA contain either the delta-12-desaturase and not the delta-6-desaturases, or vice versa.

In summary, not only was the effect of the gene copy duplication of the delta-12-desaturase surprising, but it was also unexpected that the increased copy number of delta-6-desaturase led to an increased amount of delta-6-desaturase protein, and this increased amount of protein can convert the additional amount of delta-12-desaturated fatty acids with an increased conversion rate. To illustrate the effect, here as an example of the comparison of two groups shown in examples 10 to 18 that have a gene copy number difference of “four”:

Group A: All 275 heterozygous T0 plants containing a single copy of the T-DNA of construct VC-LTM593-1qcz rc

Group B: All 64 homozygous T1 plants containing two copies the T-DNA of of construct VC-LTM593-1qcz rc at two different chromosomal loci.

In group A, the total sum of fatty acid that contain a double bond due to the activity of the delta-12-desaturase was 47.3% and total sum of fatty acids that contain a double bond due to the activity of the delta-6-desaturase was 11.2%. Consequently, 23.7% of all fatty acids that underwent delta-12-desaturation also underwent delta-6-desaturation.

In group B, the total sum of fatty acid that contain a double bond due to the activity of the delta-12-desaturase was 61 % and total sum of fatty acid that contain a double bond due to the activity of the delta-6-desaturase was 23.7%. Consequently, 38.8% of all fatty acids that underwent delta-12-desaturation also underwent delta-6-desaturation.

As a result of that, the sum of all fatty acids downstream of the delta-6-desaturase in the pathway more than doubled in group B versus group A.

This effect of increased conversion efficiency of the delta-6-desaturase has been observed when analyzing the PUFA profile of more than 6.000 plants, that have been obtained by transforming more than 300 multi-gene constructs into Canloa and Arabidopsis, whereby all of these constructs caried genes having the essential activities required for Arachidonic acid synthesis. Across these more then 300 constructs, more than 5 different delta-6-desaturase enzymes have been investigated.

Conversion efficiency of delta-6-elongation

As was evident in Figure 34, the conversion efficiency of the delta-6-elongation was very high regardless of the copy number. Because of that, copy number mediated effects on the conversion efficiency are sometimes insignificant, but are sometimes clearly observed. E.g. the events obtained for the construct combinations VC-LJB2755-2qcz rc + VC-LLM391-2qcz rc and for the combination LJB2755-2qcz rc and VC-LTM217-1qcz rc contain the lowest delta-6-elongation conversion efficiencies of all constructs, which can be attributed to the fact that these construct combinations encode just one delta-6-elongation enzyme [c-d6Elo(Tp_GA2)], instead of two [(c-d6Elo(Tp_GA2), c-d6Elo(Pp_GA2)].

Conversion efficiency of delta-5-desaturation

The data in Figure 35 do not indicate a consistent construct independent copy number dependence of the delta-5-desaturase.

Conversion efficiency of omega-3-desaturation

Figure 36 shows the omega-3-desaturase conversion efficiencies that have been calculated by excluding the C18 substrates and products shown in Figure 2, thereby excluding the delta-15-desaturase specific activity of omega-3-desaturases. Figure 37 shows the omega-3-desaturase conversion efficiencies that have been calculated by including the C18 substrates and products, thereby including the delta-15-desaturase specific activity of omega-3-desaturases. As both omega-3-desaturases used in the invention have virtually no delta-15-desaturase activity, conclusions on the effect of copy number on the omega-3-desaturase are best drawn from Figure 36. While not as pronounced as observed for the delta-12-desaturase or delta-6-desaturase, there is, in many cases, a clear link between omega-3-desaturase copy number and the omega-3-desaturase conversion efficiency. This was particularly evident as plants of the construct combination as VC-LJB2197-1qcz + VC-LLM338-3qcz rc display the lowest omega-3-desaturase conversion efficiency of all other constructs, which can be attributed to the fact that this construct combination encodes just one omega-3-desaturase enzyme [c-o3Des(Pi_GA2)], instead of two

[(c-o3Des(Pi_GA2), c-o3Des(Pir_GA)]. Exceptions to the copy number dependence of the omega-3-desaturase conversion efficiency are:
1) Plants containing the T-DNAs of construct RTP10690-1qcz_f, and
2) Plants containing the T-DNAs of construct VC-LTM595-1qcz rc, and
3) Plants containing the T-DNAs of VC-LJB2197-1qcz and VC-LLM338-3qcz rc, and

Conversion efficiency of delta-5-elongation

The complex interdependency of all the pathway step conversion efficiencies between each other can be seen by comparing Figure 38 with Figure 35: the high delta-5-elongation conversion efficiency for two groups of plants containing the T-DNAs of construct VC-LTM593-1qcz rc (813 T1 plants of the double copy group, 700 plants of the double copy/single locus group) was in fact not due to a high delta-5-elongation conversion efficiency, but rather due to an inefficient supply of substrate to the delta-5-elogase at the delta-5-desaturase pathway step. Similar to the omega-3-desaturase, while not as pronounced as for the delta-12-desaturase or delta-6-desaturase, there was a link between delta-5-elongase copy number and the delta-5-elongase conversion efficiency.

Conversion efficiency of delta-4-desaturation

As can be seen in Figure 39, there was no direct evidence for a dependence of delta-4-desaturase conversion efficiency on delta-4-desaturase copy number. The highest delta-4-desaturase conversion efficiency has been observed for plants containing the T-DNAs of construct LJB2755-2qcz rc and VC-LTM217-1qcz rc. This construct combination differs only from the combination VC-LJB2755-2qcz rc + VC-LLM391-2qcz rc in replacing the d4Des(Eg) by the c-d4Des(Pl_GA)2. As a conclusion of the plant data shown in Example 10 to 18 and the yeast data shown in Example 22, it can be clearly seen that the delta-4-desaturation conversion efficiency reaches an upper limit using the genes c-d4Des(Tc_GA) and d4Des(Eg), that cannot be overcome by increased gene copy numbers. All constructs that encode the c-d4Des(Pl_GA)2 instead of d4Des(Eg) have a higher delta-4-desaturation conversion efficiency, and the only exception to that are plants containing the construct RTP10690-1qcz_F. As shown in Example 25, this was due to very low expression of both delta-4-desaturases. This in turn highlights that the conversion efficiency does depend on the gene expression, but cannot overcome an upper limit.

Example 20: Environmental effects on VLC-PUFA levels. Correlation between oil content, VLC-PUFA levels, and observed conversion efficiencies at each pathway step

Analysing the VLC-PUFA levels presented in the Examples 10 to 18, we have oberserved that there is, in most cases, a level of variability, within a genetically identical population of plants (e.g. a genetically stable event where all plants are genetically identical), even when these plants are grown in a controlled greenhouse environment. To illustrate the effect more clearly, VLC-PUFA profiles of seed batches having highest EPA+DHA levels among several type of plant populations are shown in the examples 10 to 18. Such plant populations are (1) either genetically identical due to the T-DNA integrations (i.e. all plants of the same event, where either all or at least most are homozygous for all T-DNA integrations in those events), or (2) identical related to the T-DNA copy number, and these populations have been grown in the same environment. For example, out of 249 segregating T1 seedlings, 10 T1 plants for event LBFDAU (see Example 18) have been identified in the greenhouse to be identical in having one complete T-DNA integration, and one truncated T-DNA integration, whereby both T-DNA insertions where found to be homozygous (Table 135). In a field trial conducted in parallel, out of about segregating T1 seedlings, 4 plants have been identified as being homozygous for both T-DNA insertions (Table 144). The average EPA+DHA content measured in randomly selected seed from seed batches of these 10 greenhouse grown plants was found to be 13.9% EPA + 2.6% DHA. Similarly, the EPA+DHA content of the 4 field grown plants was found to be 13.4% EPA + 2.7% DHA. Among the 10 greenhouse grown plants was a plant that produced up to 15.1% EPA + 3.0% DHA (Table 139). Similarly, among the 4 field grown plants was a plant that produced up to 17.6% EPA + 3.6% DHA (Table 146). Analysing single seed of this field grown plant, single seeds having up to 26.2% EPA + 4.9% DHA, or 23.6%EPA + 5.8% DHA where found (Table 147). The lowest EPA+DHA content found among these 95 seed contained 13.5% EPA and 2.5% DHA, and the average content among these seed was 18.2% EPA and 3.7% DHA, which matched the content measured in the random selection of twice 15 seed as shown in Table 146 (17.6% EPA + 3.6% DHA). This event LBFDAU is just a representative example to illustrate that for every event, and for all constructs, there is plant-to-plant variability, and seed-to-seed variability. The extent of the plant to plant variability is shown in the examples 10 to 18, where it is shown that the average PUFA profile of a certain population (e.g. all plants belonging to the same event and are genetically identical, or all plants are single copy, heterozygous) is always different than the profile observed in individual plants. To illustrate the magnitude of this variability, examples 10 to 18 show the average PUFA profile of such populations and also the profile of the single plant having the highest EPA+DHA levels.

While the event LBFDAU was capable of producing in a genetically identical plant population ~13.5% EPA + 2.6% DHA in a given environment, there are individual plants within this population that produce up to ~18% EPA + 3.7% DHA as an average of all seeds produced by this plant, and single seed of this plant can reach up to ~26% EPA and ~5% DHA. These differences in EPA+DHA levels are due to the interaction of the genetic constituents of the event with the environment. However, it was consistently observed that comparable populations yield higher VLC-PUFA levels in the greenhouse compared to the field. This trend usually correlates with lower oil content in the greenhouse, compared to the field. To investigate this observation in more detail, oil content measured in all homozygous seed batches of the single copy event LANPMZ (event described in example 11) was plotted in Figure 40 against the sum of all VLC-PUFA that are downstream of the delta-12-desaturase (see Figure 2) measured in the same seed batches. The same has been done for event LAODDN (event described in example 13), and is plotted Figure 41. This analysis was also done for two events described in example 18, namely for event LBFGKN (Figure 42), and for event LBFLFK (Figure 43). What was observed is a strong correlation between these two parameters. The same analysis for wildtypes (Figure 72) reveals no such correlation, instead, Figure 72 shows a difference between greehouse grown and field grown wildtype plants, in that field grown wildtype plants have higher levels of 18:2n-6 and 18:3n-3 and lower 18:1n-9 compared to greenhouse grown wildype plants.

To analyse in detail if this correlation depicted for event LANPMZ in Figure 40 can be attributed to certain pathway steps, conversion efficiencies for each pathway step and for each seedbatch analysed in Figure 40 have been calculated, and plotted in Figure 44, Figure 48, Figure 52, Figure 56, Figure 60, Figure 64, and Figure 68. The same analysis has been done for event LAODDN, and is plotted in Figure 45, Figure 49, Figure 53, Figure 57, Figure 61, Figure 65 and Figure 69. The same analysis was also been done for event LBFGKN, (plotted in Figure 46, Figure 50, Figure 54, Figure 58, Figure 62, Figure 66 and Figure 70), and for event LBFLFK (Figure 47, Figure 51, Figure 55, Figure 59, Figure 63, Figure 67 and Figure 71). Comparing all these figures, one can see that the correlation observed in Figure 40 and Figure 41 is largely attributed to the delta-12-desaturase pathway step (Figure 44 to Figure 47), the delta-6-desaturase pathway step (Figure 48 to Figure 51), and the delta-4-desaturase pathway step (Figure 68 to Figure 71): in these figures, there is a construct and event independent negative correlation between the pathway steps and the seed oil content visible, which cannot be observed for the other pathway steps.

The negative correlation of the delta-12-desaturase pathway with seed oil content in event LANPMZ was observed in wild type plants, as shown in Figure 72. Moreover, Figure 72 shows that field grown wildtype plants have higher levels of 18:2n-6 and 18:3n-3 and lower 18:1n-9 compared to greenhouse grown wildype plants. This can most likely be explained with previous observations (Xiao et al. 2014), in that the native Canola endogenous delta-12-desaturase was regulated by temperature and that temperature regulation of delta-12-desaturase at the transcript level and protein level is a recurring theme in plants (Kargiotidou et al. 2008, Tang et al. 2005, Sanchez-Garcia et al. 2004), whereby under field conditions the delta-12-desaturase would be up-regulated compared to greenhouse conditions. However, it can be concluded that there was no regulation of the delta-12-desaturase in dependance of the oil content observed in wildtype canola plant. Consequently comparing Figure 72 with Figure 40 to Figure 43), it can furthermore be concluded that only the introduced transgeneic delta-12-desaturase was subject to a regulation that was seed oil content dependent.

A further observation is that field grown transgenic plants do not have a higher delta-12-desaturase conversion efficiency compared to greenhouse grown plants, even though this was clearly oberved for wildtype plants in Figure 72. It can be concluded that the endogenous native delta-12-desaturase does not significantly contribute to the overall observed delta-12-desaturase conversion efficiency in the transgenic plants of the invention.

In addition to plotting pathway step conversion efficiencies vs seed oil content, levels of some key fatty acids have been plotted agains seed oil content (Figure 81, Figure 82, Figure 83, Figure 84). The data have been fitted in those figures by using all datapoints of all depicted events to determine the slope of the regression, and by subsequently using all datapoints for single events to determine the intercept of the regression line with the x-axis (0% oil content) of the regressions shown in (Figure 81, Figure 82, Figure 83, Figure 84). The results of this analysis are shown in Table 158.

Table 158: Regression equations of fitting the data in Figure 81, Figure 82, Figure 83, Figure 84 as described in example 20. Listed are the parameters for the equation (Fatty acid) = (seed oil content) * Slope + Intercept.

Event		EPA+DHA vs oil		ARA vs oil		EPA vs oil		DHA vs oil	
	N	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope
LBFDAU	23	28.054	-0.398	5.774	-0.098	22.053	-0.288	6.003	-0.110
LBFPRA	44	26.075	-0.398	7.399	-0.098	20.762	-0.288	5.315	-0.110
LBFLFK	42	25.280	-0.398	5.788	-0.098	19.578	-0.288	5.703	-0.110
LBFDHG	9	25.058	-0.398	5.235	-0.098	19.167	-0.288	5.892	-0.110
LANBCH	60	24.910	-0.398	7.142	-0.098	19.305	-0.288	5.606	-0.110
LBFGKN	291	23.481	-0.398	5.856	-0.098	17.994	-0.288	5.488	-0.110
LBFIHE	47	22.841	-0.398	6.086	-0.098	17.489	-0.288	5.353	-0.110
LBFDGG	44	22.800	-0.398	5.789	-0.098	17.403	-0.288	5.398	-0.110

Example 21: In vitro demonstration of enzyme activity

Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast

Expression of desaturases and elongases was accomplished in *Saccharomyces cerevisiae*. Briefly, yeast strains containing the appropriate plasmid were grown overnight at 30 °C (in SD-medium-uracil + raffinose) and then used to inoculate a larger culture at a starting OD_{600} = 0.2 (in SD-medium-uracil+raffinose+galactose). After 24 hours at 30 °C the culture (typically OD_{600} = 0.6-0.8) was harvested by centrifugation and washed once in 25 mM Tris Buffer (pH 7.6). Preparation of crude extracts and microsomes from yeast expressing genes encoding desaturases and elongases was accomplished using standard procedures. Briefly, cells expressing desaturases were resuspended in 2 ml Desaturase Disruption Buffer (0.1M potassium phosphate pH 7.2, 0.33 M sucrose, 4 mM NADH, 1 mg/ml BSA (fatty acid free), 4000 U/ml catalase and protease inhibitors (Complete EDTA-free (Roche)) and disrupted using silica/zirconium beads in a BeadBeater. The crude extract was clarified by centrifugation twice at 8,000xg, 4 °C). After an additional centrifugation at 100,000xg (30 minutes at 4 °C) the microsomes were pelleted and ultimately resuspended in Desaturase Disruption Buffer (300 microliters). Protein concentrations in both the crude extract and microsomes were measured using the bicinchoninic acid (BCA) procedure (Smith, P. K., et al (1985) *Anal. Biochem.* (150): 76–85).

General Desaturase Activity Assays:

In the desaturase assay a [^{14}C]-labeled acyl-CoA was provided as a substrate and after the reaction the acyl-CoAs (and phospholipids) were hydrolyzed and methylated to fatty acid methyl esters (FAMEs), which were analyzed using argentation-TLC. The general assay conditions were modified from Banas et al. (Banas et al. (1997) *Physiology, Biochemistry and Molecular Biology of Plant Lipids* (Williams, J.P., Khan, M.U. and Lem, N.W. eds.) pp. 57-59).

The assay contained: 1 mg enzyme (crude extract) or 150 μg (microsomal fraction), 10 nmol [^{14}C]-acyl-CoA (3000 dpm/nmol), 7.2 mM NADH (total), 0.36 mg BSA (total) in a buffer comprised of 0.1 M K-phosphate pH 7.2, 0.33 M sucrose, 4 mM NADH, 1 mg/ml BSA and protease inhibitors in a total volume of 200 μl. After incubation at 30 °C for the desired time, 200 μl of 2 M KOH in MeOH:H_2O (1:4) was added and incubated for 20 minutes at 90 °C. Fatty acids were extracted by addition of 3 M HCl (200 μl), 1.5 ml of MeOH:$CHCl_3$ (2:1) and $CHCl_3$ (500 μl). The chloroform phase was recovered, dried under N_2(g) and fatty acids were methylated by addition of 2 ml MeOH containing 2% H_2SO_4 and incubation of 30 minutes at 90 ˚C. FAMEs were extracted by addition of 2 ml H_2O and 2 ml hexane and separated by $AgNO_3$-TLC and Heptane:Diethyl ether:Acetic Acid (70:30:1) as a solvent. The radioactive lipids were visualized and quantified by electronic autoradiography using Instant Imager.

Delta-12 desaturase (*Phytophthora sojae*), c-d12Des(Ps_GA) Enzyme Activity: Enzyme assays were performed using re-suspended microsomes isolated from a yeast strain expressing the c-d12Des(Ps_GA) protein and compared to microsomes isolated from a control yeast strain containing an empty vector (LJB2126). In the presence of [^{14}C]18:1n-9-CoA, 16:0-lysphosphatidylcholine (LPC), and NADH membranes containing c-d12Des(Ps_GA) form an [^{14}C]18:2-fatty acid that can be isolated as a methyl ester and resolves on $AgNO_3$-TLC [heptane:diethyl ether (90:10)] similar to known synthetic standards. This enzyme activity requires NADH and was not observed in membranes isolated from the empty vector control strain. Control assays without 16:0-LPC contain a small-amount of activity, presumably due to endogenous 16:0-LPC found in yeast microsomes. Furthermore, separation of the phospholipids from the free-fatty acids after the enzymatic reaction and characterization of the isolabled fatty acid methyl esters demonstrated that all of the c-d12Des(Ps_GA) enzymatically produced 18:2n-6-fatty acid methyl ester (FAME) was found in the phosphatidylcholine fraction.
c-d12Des(Ps_GA) enzyme activity may also be demonstrated using other [^{14}C]acyl-CoA's which may include, but are not limited to: [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA.

Delta-6 desaturase (*Ostreococcus tauri*), c-d6Des(Ot_febit) Enzyme Activity: c-d6Des(Ot_febit) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d6Des(Ot_febit) protein using an [^{14}C]acyl-CoA in the general assay described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using $AgNO_3$-TLC and Heptane:Diethyl ether:Acetic Acid (70:30:1) as a solvent. Furthermore, the c-d6Des(Ot_febit) enzyme can be shown to directly desaturate an acyl-CoA substrate, as described in "Desaturase Headgroup (CoA vs PC) Preference", as suggested in previous reports (Domergue et al. (2005) Biochem. J. 389: 483-490).

Delta-5 desaturase (*Thraustochytrium* ssp.), c-d5Des(Tc_GA2) Enzyme Activity: c-d5Des(Tc_GA2) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d5Des(Tc_GA2) protein using an [^{14}C]acyl-CoA general assay as described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using Reverse Phase-TLC (Silica gel 60 RP-18) and acetonitrile (100%) as a solvent.

Omega-3 desaturase (*Phytophthora infestans*), c-o3Des(Pi_GA2) Enzyme Activity: c-o3Des(Pi_GA2) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-o3Des(Pi_GA2) protein using [^{14}C]acyl-CoA in the general assay described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using Reverse Phase-TLC (Silica gel 60 RP-18) and acetonitrile (100%) as a solvent.

Omega-3 desaturase (*Pythium irregulare*), c-o3Des(Pir_GA) Enzyme Activity: c-o3Des(Pir_GA) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-o3Des(Pir_GA) protein using an [^{14}C]acyl-CoA in the general assay described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using Reverse Phase-TLC (Silica gel 60 RP-18) and acetonitrile (100%) as a solvent.

Delta-4 desaturase (*Thraustochytrium* ssp.), c-d4Des(Tc_GA) Enzyme Activity: c-d4Des(Tc_GA) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d4Des(Tc_GA) protein using an [^{14}C]acyl-CoA in the general assay described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using Reverse Phase-TLC (Silica gel 60 RP-18) and acetonitrile (100%) as a solvent.

Delta-4 desaturase (*Pavlova lutheri*), c-d4Des(Pl_GA)2 Enzyme Activity: c-d4Des(Pl_GA)2 enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d4Des(Pl_GA)2 protein using an [^{14}C]acyl-CoA in the general assay described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using Reverse Phase-TLC (Silica gel 60 RP-.18) and acetonitrile (100%) as a solvent.

Delta-4 desaturase (*Euglena gracilis*), c-d4Des(Eg) Enzyme Activity: c-d4Des(Eg) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d4Des(Eg) protein using an [^{14}C]acyl-CoA in the general assay described above. [^{14}C]Acyl-CoA's may include, but are not limited to: [^{14}C]18:1n-9-CoA, [^{14}C]18:2n-6-CoA, [^{14}C]20:3n-6-CoA, [^{14}C]20:4n-6-CoA, [^{14}C]22:5n-3-CoA. Isolated fatty acid methyl esters derived from enzymatic substrates and products can be resolved using Reverse Phase-TLC (Silica gel 60 RP-18) and acetonitrile (100%) as a solvent.

Desaturase Activity in Microsomes isolated from Transgenic *Brassica napus*.

Microsomes containing recombinant desaturases and elongases capable of synthesizing docosahexaenoic acid (22:6n-3) were isolated from immature seeds from transgenic *B. napus* using a procedure adopted from Bafor, M. et al. Biochem J. (1991) 280, 507-514. Briefly, immature seeds were first seperated from canola pods and then the developing embryos were isolated from the seed coat and transferred to ice-cold 0.1M Phosphate buffer (pH 7.2). The developing embryos were then washed with fresh Phosphate buffer, transferred to an ice-cold mortar, and ground to a homogenous solution in Extraction Buffer (0.1 M Phosphate, pH 7.2, 0.33 M sucrose, 1 mg/ml BSA (essentially fatty acid free), 4000U/ml catalase, 4 mM NADH and protease inhibitor-Complete EDTA-free (Roche)). The lysed developing embryo's were diluted 20-fold with additional Extraction Buffer and passed through 2 layers of Miracloth into a centrifuge tube. Following centrifugation at 18,000 x g for 10 minutes at 4 °C, the clarified supernatant was passed through Miracloth into an ultracentrifuge tube. Following centrifugation at 105, 000 xg for 60 minutes at 4 °C, the supernatant was removed from the microsomal pellet, which was then washed once with Extraction Buffer, and then using a Dounce homogenizer resuspended as a homogenous solution in Extraction Buffer (about 1 ml per 500 embryo's).

Enzyme activity can be demonstrated for the desaturases using the assays described above in "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast" for microsomes isolated from yeast expression strains.

In summary in "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast"we have provided a method that allows unambiguous demonstration of fatty acyl desaturase enzyme activity. We provide data demonstrating that: (1) gene c-d12Des(Ps_GA) encodes a delta-12 desaturase protein from *Phytophthora sojae* (c-d12Des(Ps_GA) that desaturates oleic acid (18:1n-9) to form linoleic acid (18:2n-6) in both microsomes isolated from a transgenic yeast (Figure 24, panel A) and from a transgenic *B. napus* event (Figure 25, panel A) expressing this protein, (2) gene c-o3Des(Pi_GA2) encodes a protein from *Phytophthora infestans* (c-o3Des(Pi_GA2)) that desaturates arachidonic acid (20:4n-6) to form eicosapentaenoic acid (20:5n-3) in microsomes isolated from a transgenic yeast (Figure 24, panel B) expressing this protein, (3) gene c-o3Des(Pir_GA) encodes an omega-3 desaturase protein from *Pythium irregulare* (c-o3Des(Pir_GA)) that desaturates arachidonic acid (20:4n-6) to form eicosapentaenoic acid (20:5n-3) in microsomes isolated from a transgenic yeast (Figure 24, panel B) expressing this protein, (4) a transgenic *B. napus* event containing genes encoding omega-3 desaturase proteins from both *Phytophthora infestans* (c-o3Des(Pi_GA2)) and *Pythium irregulare* (c-o3Des(Pir_GA)) that contains at least one enzyme, localized to the microsomes, capable of desaturating arachidonic acid (20:4n-6) to form eicosapentaenoic acid (20:5n-3) (Figure 85, Panel C), (5) gene c-d4Des(Tc_GA) encodes a delta-4 desaturase protein from *Thraustochytrium* sp. (c-d4Des(Tc_GA)) that desaturates docosapentaenoic acid (22:5n-3) to form docosahexaenoic acid (22:6n-3) in microsomes isolated from a transgenic yeast (Figure 24, panel C) expressing this protein, (6) gene c-d4Des(Pl_GA)2 encodes a delta-4 desaturase protein from *Pavlova lutheri* (c-d4Des(Pl_GA)2 that desaturates docosapentaenoic acid (22:5n-3) to form docosahexaenoic acid (22:6n-3) in microsomes isolated from a transgenic yeast (Figure 24, panel D), (7) a transgenic *B. napus* event containing both the gene encoding the delta-4 desaturase protein from *Thraustochytrium* sp, gene c-d4Des(Tc_GA), and the gene c-d4-Des(Pl_GA) from *Pavlova Lutheri* contains at least one enzyme, localized to the microsomes, capable of desaturating docosapentaenoic acid (22:5n-3) to form docosahexaenoic acid (22:6n-3) (Figure 25, panel C),

(8) a transgenic *B. napus* event containing the gene encoding a delta-6 desaturase protein from *Ostreococcus tauri* (c-d6Des(Ot_febit), capable of desaturating linoleic acid (18:2n-6) to form gamma-linolenic acid (18:3n-6) (Figure 85, Panel A), and (9) a transgenic *B. napus* event containing the gene encoding a delta-5 desaturase protein from *Thraustachytrium* ssp. (c-d5Des(Tc_GA2), capable of desaturating dihomo-gamma-linolenic acid (20:3n-6) to form arachidonic acid (20:4n-6) (Figure 85, Panel B). Except for the c-d12Des(Ps_GA), which has a known endogenous enzyme in Brassica, all other examples presented contain no detectable endogenous desaturase activity in microsomes isolated from either control yeast strains (Figure 24) or control *Brassica* lines (Figure 25 and Figure 85).

Using the methods described in “Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast” for desaturase proteins the level of expression or detected enzyme activity may be influenced by the presence or absence of fusion tags to the native protein. Fusion tags or proteins to the desaturases may be attached the amino-terminus (N-terminal fusions) or the carboxy-terminus (C-terminal fusions) of the protein and may include but are not limited to: FLAG, hexa-Histidine, Maltose Binding Protein, and Chitin Binding Protein.

We have provided methods to establish enzyme catalyzed desaturation reactions required in an engineered pathway to biosynthesize docosohexaenoic acid (DHA, 22:6n-3) from oleic acid (18:1n-9) in canola. The methods presented in Example 21, “Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast” were developed to demonstrate desaturase activity in yeast strains expressing individual desaturases and can be further used to confirm the respective desaturase enzyme activities in transgenic canola, as described and demonstrated in Example 21, ”Desaturase Activity in Microsomes Isolated from Transgenic *Brassica napus*”. Furthermore these methods can be incorporated, by one skilled in the art, to measure desaturase enzyme activities in other organisms including, but not limited to: *Saccharomyces cerevisiae*, *Arabidopsis thaliana*, *Brassica* spp., *Camelina sativa*, *Carthamus tinctorius*, and *Salvia hispanica*.

Desaturase Headgroup (CoA vs PC) Preference

Fatty acid desaturases catalyze the abstraction of two hydrogen atoms from the hydrocarbon chain of a fatty acid to form a double bond in an unsaturated fatty acid and can be classified according to the backbone that their substrate was connected to: an acyl-CoA, an acyl-ACP (ACP, acyl carrier protein) or an acyl-lipid. To date a few examples exist where the acyl-CoA substrate has been confirmed. These involve purified enzymes and examples include a Linoleoyl-CoA Desaturase (Okayasu et al. (1981) Arch. Biochem. Biophys. 206: 21-28), a stearoyl-CoA desaturase from rat liver (Strittmatter et al (1974) Proc. Nat. Acad. Sci. USA 71: 4565-4569), and a Stearoyl-ACP desaturase from avocado (Shanklin J and Somerville C (1991) Proc Natl Acad Sci USA 88:2510-2514).

Alternatively, Heinz and coworkers have reported a strategy employing *in vivo* feeding of substrates to yeast strains expressing desaturases to examine substrate specificity of desaturases (Domergue et al. (2003) J. Biol. Chem. 278: 35115-35126 , Domergue et al. (2005) Biochem. J. 389: 483-490). In these studies predictions of a desaturases’s preference for acyl-lipid substrates were based on data obtained from a thorough analysis of the desaturated products in the CoA, phospholipid and neutral lipid pools over a growth time course. However, highly active endogenous acyltransferases which transfer acyl-groups between various pools (e.g. CoA, ACP, and lipid) may influence or convolute these data (Domergue et al. (2005) Biochem. J. 389: 483-490, Meesapyodsuk, D., Qui, X. (2012) Lipids 47: 227-237). Therefore this approach was still limited by the absence of direct evidence, such as obtained from *in vitro* assays, needed for conclusive determination of the substrate backbone utilized by the desaturase of interest.

Herein, we provide a previously unreported method to distinguish between enzymes that desaturate acyl-CoA fatty acids from enzymes that desaturate phospholipid linked fatty acids using microsomal preparations of proteins. We have improved upon initial reports of strategies to generate [^{14}C]-phosphatidylcholine analogs *in situ* (Stymne, S., and Stobart, A. K. (1986) Biochem. J. 240: 385-393, Griffiths, G., Stobart, A. K., and Stymne, S. (1988) Biochem. J. 252: 641-647) by: (1) monitoring the initial acyl-transfer reaction catalyzed by lysophosphatidyl choline acyl transferase (LPCAT) to establish that all of the [^{14}C]-acyl-CoA has been consumed, and (2) including exogenous lysophosphatidyl choline (LPC). Our improvements therefore establish that only [^{14}C]-phosphatidylcholine analogs are present upon initiation of the desaturase assay and allow for testing of other phospholipids by adding their corresponding lysolipid. Furthermore, the assays testing for desaturation of acyl-phospholipid substrates, described in <u>Demonstration of Phosphatidylcholine Specificity</u>, can be complemented by testing in an assay developed to monitor desaturation of the substrate in the acyl-CoA form. Specifically, we have devised a strategy, described in <u>Demonstration of acyl-CoA Specificity</u>, in which the substrate to be tested remains in its acyl-CoA form and is not incorporated into phospholipids (e.g. phosphatidylcholine) by lysophosphatidyl choline acyl transferase (LPCAT). By comparing the relative desaturase activity, observed in assays where the substrate is in the acyl-phospholipid form compared to the acyl-CoA form, the actual backbone (e.g. phosphatidylcholine or CoA) covalently bound to the desaturated fatty acid product can be determined.

<u>Demonstration of Phosphatidylcholine Specificity</u>:
To test if a desaturase accepts an acyl-lipid (e.g. a phospholipid) substrate the enzyme reaction was performed as described above " "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast", but after a pre-incubation in the presence of exogenous lysophosphatidyl choline (LPC). The microsomal fraction of the yeast strain expressing the enzyme of interest was pre-incubated with a [^{14}C]-labelled acyl-CoA substrate in the presence of 16:0-lysophosphatidyl choline, which was typically 50 μM but may vary from 0 – 500 μM. During the pre-incubation endogenous lysophosphatidyl choline acyl transferase (LPCAT), present in the microsomes, transfers the [^{14}C]fatty acid from CoA to 16:0-LPC generating, *in situ*, a [^{14}C]fatty acid-phosphatidylcholine (PC) (Jain et al. (2007) *J. Biol. Chem.* 282:30562-30569, Riekhof et al. (2007) *J. Biol. Chem.* 282:36853-36861, Tamaki et al. (2007) *J. Biol. Chem.* 282:34288-34298)). After a pre-incubation (typically 15 minutes, but may vary from 1 – 300 minutes) essentially all of the [^{14}C]-labelled acyl-CoA substrate was consumed, as measured by scintillation counting and TLC analysis of the aqueous phase.

The reaction was stopped and lipids were extracted using the method of Bligh and Dyer (Bligh, E. G., and Dyer, J. J. (1959) *Can J. Biochem. Physiol.* 37: 911-918), by addition of 200 µl 0.15 M acetic acid and 1 ml MeOH:$CHCl_3$ (1:1). Part (about 10%) of the $CHCl_3$ phase (containing phosphatidyl choline (PC) and free fatty acids (FFA's)) was analyzed by scintillation counting and the rest was applied to a silica thin layer chromatography (TLC) plate. The plate was first developed in a polar solvent [$CHCl_3$:MeOH:acetic acid (90:15:10:3) and then in Heptane:diethylether:acetic acid (70:30:1) to measure incorporation into PC and the amount of FFA's (likely generated by thioesterases). PC and FFA's were scraped off the plate and methylated by addition of MeOH containing 2% H_2SO_4 at 90 °C for 30 minutes. The methyl esters were extracted in hexane and analyzed as described above for the respective enzymes (Example 21, "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast"). The upper (aqueous) phase of the reaction mixture extraction contains acyl-CoA's and was hydrolyzed by addition of an equal volume of 2 M KOH in MeOH:H_2O (1:4) and incubated for 20 minutes at 90 °C. Part of the aqueous phase was then analyzed by scintillation counting before fatty acids were extracted by addition of 3 M HCl (0.7 ml), 1.4 ml of MeOH) and $CHCl_3$ (1.9 ml). The chloroform phase was recovered, dried under N_2(g) and fatty acids were methylated by addition of 2 ml MeOH containing 2% H_2SO_4 and incubation of 30 minutes at 90 °C. FAMEs were extracted by addition of 2 ml H_2O and 2 ml hexane and separated by $AgNO_3$-TLC and Heptane:Diethyl ether:acetic acid (70:30:1) as a solvent or Reverse Phase-TLC (Silica gel 60 RP-18 using acetonitrile (100%)). The radioactive lipids were visualized and quantified by electronic autoradiography using Instant Imager.

<u>Delta-12 desaturase (*Phytophthora sojae*), c-d12Des(Ps_GA) Substrate Preference</u>: The c-d12Des(Ps_GA) enzyme activity demonstrated in "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast"can be further characterized to establish the backbone of the oleic acid substrate. In the desaturase assay described in "Desaturase Headgroup (CoA vs PC) Preference" containing 16:0-lysphosphatidylcholine (LPC) substantial desaturation was observed. A significantly reduced, but detectable, desaturase activity was observed in control reactions lacking 16:0-LPC which likely results from acylation of endogenous LPC present in the yeast microsomes containing the d12Des(Ps_GA) protein. However, a preincubation with 20:1n-9-CoA results in PC saturated with 20:1n-9, thus precluding incorporation of [^{14}C]-18:1n-9 into PC (described in "Demonstration of Acyl-CoA Specificity"). Additionally, separation of the phospholipids from the free-fatty acids after the enzymatic reaction and characterization of the isolable fatty acid methyl esters demonstrated that all of the d12Des(Ps_GA) enzymatically produced 18:2n-6-fatty acid methyl ester (FAME) was found in the phosphatidylcholine fraction (Figure 26, Panel A and Figure 86, Panel A). Furthermore, the d12Des(Ps_GA) activity was negligible in the assay for demonstration of acyl-CoA specificity (Figure 86, Panel B), showing that 18:1n-9-acyl-CoA is not a preferred substrate for the delta-12 desaturase (*Phytophthora sojae*). In conclusion, delta-12 desaturase (*Phytophthora sojae*) clearly desaturates 18:1n-9 covalently bound to PC, but not an 18:1n-9-acyl CoA substrate.

<u>Delta-4 desaturase (*Thraustochytrium* ssp.), c-d4Des(Tc_GA) Substrate Preference</u>: The c-d4Des(Tc_GA) enzyme activity demonstrated in "Desaturase Enzyme Activity in Microsomes

Isolated from Transgenic Yeast”can be further characterized to establish the backbone of the docosopentaenoic acid substrate. In the desaturase assay described in ”Desaturase Headgroup (CoA vs PC) Preference” without additional 16:0-lysphosphatidylcholine (LPC), desaturation was observed (Figure 26, Panel B), and likely results from the presence of endogenous 16:0-LPC present in the membranes containing the c-d4Des(Tc_GA) protein. The c-d4Des(Tc_GA) desaturase activity was dramatically stimulated by including additional 16:0-LPC in the assay (Figure 26, Panel B), consistent with the observation endogenous lysophosphatidyl choline acyl transferase (LPCAT), present in the microsomes, transfers the [^{14}C]22:5n-3 from CoA to 16:0-LPC generating a [^{14}C]22:5n-3-phosphatidylcholine (PC) that was desaturated. Additionally, separation of the phospholipids from the free-fatty acids after the enzymatic reaction and characterization of the isolable fatty acid methyl esters demonstrated that essentially all of the c-d4Des(Tc_GA) enzymatically produced 22:6n-3-fatty acid methyl ester (FAME) was found in the phosphatidylcholine fraction (Figure 26, Panel B and Panel C).

Demonstration of Acyl-CoA Specificity:

The assay conditions were as described above in “Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast”. The microsomal fraction of the yeast strain expressing the enzyme of interest was pre-incubated with 10 nmol 20:1n-9-CoA (50 µM) and 0.5 mM DTNB (5,5'-dithiobis-(2-nitrobenzoic acid) for 10 min before addition of NADH and [^{14}C]labelled acyl-CoA substrate.The preincubation with 20:1n-9-CoA minimizes the incorporation of [^{14}C]labelled substrate into PC. DTNB prevents the reverse reaction of LPCAT and thereby the entering of acyl-CoA into PC via acyl exchange. This assay may also include alternative acyl-CoA’s such as: 18:1n-9-CoA, 18:2n-6-CoA, 20:3n-6-CoA, 20:4n-6-CoA, 22:5n-3-CoA. The reaction was stopped and lipids were extracted using the method of Bligh and Dyer (Bligh, E. G., and Dyer, J. J. (1959) *Can J. Biochem. Physiol.* **37**, 911-918), by addition of 200 µl 0.15 M acetic acid and 1 ml MeOH:$CHCl_3$ (1:1). Part (about 10%) of the $CHCl_3$ phase (containing phosphatidyl choline (PC) and free fatty acids (FFA’s)) was analyzed by scintillation counting and the rest was applied to a silica thin layer chromatography (TLC) plate. The plate was first developed in a polar solvent [$CHCl_3$:MeOH:acetic acid (90:15:10:3) and then in Heptane:diethylether:acetic acid (70:30:1) to measure incorporation into PC and the amount of FFA’s (likely generated by thioesterases). PC and FFA’s were scraped off the plate and methylated by addition of MeOH containing 2% H_2SO_4 at 90 °C for 30 minutes. The methyl esters were extracted in hexane and analyzed as described above for the respective enzymes “Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast”. The upper (aqueous) phase of the reaction mixture extraction contains acyl-CoA’s and was hydrolyzed by addition of an equal volume of 2 M KOH in MeOH:H_2O (1:4) and incubated for 20 minutes at 90 °C. Fatty acids were extracted by addition of 3 M HCl (0.7 ml), 1.4 ml of MeOHand $CHCl_3$ (1.9 ml). The chloroform phase was recovered, dried under N_2(g) and fatty acids were methylated by addition of 2 ml MeOH containing 2% H_2SO_4 and incubation of 30 minutes at 90 °C. FAMEs were extracted by addition of 2 ml H_2O and 2 ml hexane and separated by $AgNO_3$-TLC and Heptane:Diethyl ether:acetic acid (70:30:1) as a solvent or Reverse Phase-TLC (Silica gel 60 RP-18 using acetonitrile (100%)). The radioactive lipids were visualized and quantified by electronic autoradiography using Instant Imager.

To demonstrate acyl-CoA dependency both methods are tested. If desaturation does not occur in the method for determining PC-specificity (LPC addition and preincubation before adding NADH) and the method for determining acyl-CoA specificity (20:1-CoA and DTNB addition) leads to the desaturated product in the H_2O-phase (or product in any of the lipid pools PC/FFA/H_2O since PC-dependent enzymes cannot be active if the substrate is not incorporated into PC (see Figure 86, Panel B), it can be concluded that the enzyme was acyl-CoA dependent (see Figure 27 and Figure 87, Panels A and B). Similarly if a desaturase demonstrates activity in the PC-specific assay, but not in the assay where the substrate is presented as an acyl-CoA, then it can be concluded the enzyme utilizes a fatty acid covalently attached to phosphatidylcholine as a substrate.

<u>Delta-9 desaturase (*Saccharomyces cerevisiae*), d9Des(Sc) Substrate Preference:</u>
Analysis of the [^{14}C]-distribution during of the d9Des(Sc) reaction, in the assay for demonstration of acyl-CoA dependency, shows that greater than 95% of the radioactivity (substrate and product) is present in the H_2O (CoA) and FFA-pools (data not shown), indicating incorporation into PC was insignificant. During the reaction, product (16:1n-9) in the acyl-CoA pool increases linearly up to 60 minutes, showing that the enzyme preferentially converts 16:0 covalently bound to CoA (Figure 87, Panel B). The amount of 16:1n-9 in the H_2O fraction then levels out or slightly decreases, while the 16:1n-9 in the FFA pool increases, due to degradation of acyl-CoA by thioesterases present in the isolated membranes.

In the assay for demonstrating PC specificity, the d9Des(Sc) showed no activity (Figure 87, Panel A), which indicates that when16:0 fatty acid is attached to PC (or a FFA) it is not a preferred substrate.

The clear presence of desaturase activity in the “Acyl-CoA Specific” assay compared to the absence of activity in the “Phosphatidylcholine Specific” assay demonstrates that the delta-9 desaturase (*Saccharomyces cerevisiae*) utilizes 16:0 covalently attached to Coenzyme A. Interestingly, recent crystal structures of both the human and mouse stearoyl-coenzyme A desaturases have been reported with bound stearoyl-CoA confirming that this desaturase utilizes a coenzyme A substrate (Wang et al (2015) Nat Struct Mol Bio 22: 581-585 and Bai et al (2015) Nature 524: 252-257).

In summary, we presented a previously unreported method to distinguish between enzymes that desaturate acyl-CoA fatty acids from enzymes that desaturate phospholipid linked fatty acids. This embodment of the invention t uses microsomal preparations of enzymes and does not, as in previous examples, require purification of the enzyme of interest. Furthermore, this embodiment allows isolation of the intact desaturated enzymatic product, allowing characterization of the backbone to which it was linked (e.g. lipid-, CoA-, or free fatty acid). An important consideration was that the endogenous lysophosphatidyl choline acyl transferase (LPCAT) present in yeast-derived microsomes can utilize a broad range of acyl-CoA’s (Jain et al. (2007) *J. Biol. Chem.* 282:30562-30569, Riekhof et al. (2007) *J. Biol. Chem.* 282:36853-36861, Tamaki et al. (2007) *J. Biol. Chem.* 282:34288-34298)) making it suitable for generating an extensive variety of different phosphatidylcholine derivatives for assaying desaturase enzymes. LPCAT is able to accept 18:1n-9-CoA and 20:4n-6-CoA and this enzyme can acylate LPC with 22:5n-3-CoA.. Microsomes isolated from any cells or tissue can be used in this embodiment of the invention, including but not limited to bacterial cells (e.g. *Escherichia coli*, *Psuedomonas aeruginosa*, *Bacillus thuringiensis*), mammalian tissue (e.g. liver) and plant tissue (e.g. leafs, roots, seeds, and pods) and could use exogenously supplied lysophosphatidyl choline acyl transferase from *Saccharomyces cerevisiae*, if necessary. Slight modifications to the general method presented here may include a pre-incubation with alternate acyl-CoA's, not the potential desaturase substrate, which could reduce the observed background due to endogenous LPC present in the membranes and also minimize thioesterase degradation of enzyme substrate or product acyl-CoA's.

Elongase Activity.

Expression of elongase enzymes in yeast was performed as described above for the desaturase enzymes in "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast". Isolation of microsomes containing expressed elongases was generally as described above in "Desaturase Enzyme Activity in Microsomes Isolated from Transgenic Yeast" and by Denic (Denic, V. and Weissman (2007) Cell 130, 663-677). Briefly, cells from a yeast expression culture (50 ml) were resuspended in 1 ml of Elongase Disruption Buffer (20 mM Tris-HCl, pH 7.9, 10 mM $MgCl_2$, 1 mM EDTA, 5% glycerol, 0.3 M ammonium sulfate, protease inhibitor), mixed with 1 ml silica/zirconium beads (0.5mm) and disrupted in a BeadBeater. After centrifugation (two times for 5 minutes at 8000xg, 4 °C) the crude extract was recovered and after a second centrifugation (100,000xg, 2 hours at 4 °C), the microsomal fraction was resuspended in 500 µl of assay buffer (50 mM HEPES-KOH pH 6.8, 150 mM KOAc, 2 mM MgOAc, 1 mM $CaCl_2$, protease inhibitor). The protein concentrations in the microsomes were measured according to the BCA method. Resuspended microsomes were aliquoted and frozen in N_2(l) and stored at -80 °C.

In the elongase assay [^{14}C]-labeled malonyl-CoA and non-labeled acyl-CoA were provided as substrates. After the reaction has proceeded an appropriate time, which may vary between 0 - 300 minutes depending on the purpose of the experiment, the reaction mixture was subjected to hydrolysis and methylation and the FAMEs were analyzed by RP-TLC combined with by electronic autoradiography using Instant Imager.

The assay contains about 170 µg microsomal protein, 7.5 nmol [^{14}C]malonyl-CoA (3000 dpm/nmol), 5 nmol acyl-CoA in a total volume of 100 µl. After incubation for the desired time at 30 °C, the reaction was stopped with the addition of 100 µl of 2 M KOH in MeOH (1:4) followed by a 20 minute incubation at 90 °C. Fatty acids were extracted by addition of 3 M HCl (100 µl), 0.75 ml of MeOH:$CHCl_3$ (2:1) and $CHCl_3$ (250 µl). The chloroform phase was recovered, dried under N_2(g), and fatty acids were methylated by addition of 2 ml MeOH containing 2% H_2SO_4 and incubation of 30 minutes at 90 °C. FAMEs were extracted by addition of 2 ml H_2O and 2 ml hexane and separated by Reverse Phase-TLC (Silica gel 60 RP-18) using a solvent of acetonitrile:tetrahydrofuran (85:15). The radioactive lipids were visualized and quantified by electronic autoradiography using Instant Imager.

Furthermore, assays may include additional components (e.g. 1 mM NADPH, 2 mM $MgCl_2$, and 100 μM cerulenin) to complete the fatty acid reduction cycle by endogenous yeast enzymes, but limit further elongation of the acyl- CoA.

Delta-6 Elongase (*Thalassiosira pseudonana*), c-d6Elo(Tp_GA2) Enzyme Activity: c-d6Elo(Tp_GA2) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d6Elo(Tp_GA2) protein using [^{14}C]malonyl-CoA and an acyl-CoA in the general elongase assay described above. Acyl-CoA's may include, but are not limited to: 18:1n-9-CoA, 18:2n-6-CoA, 18:3n-6-CoA, 20:3n-6-CoA, 20:4n-6-CoA, 20:5n-3-CoA, 22:5n-3-CoA.

Delta-6 Elongase (*Physcomitrella patens*), c-d6Elo(Pp_GA2) Enzyme Activity: c-d6Elo(Pp_GA2) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d6Elo(Tp_GA2) protein using [^{14}C]malonyl-CoA and an acyl-CoA in the general elongase assay described above. Acyl-CoA's may include, but are not limited to: 18:1n-9-CoA, 18:2n-6-CoA, 18:3n-6-CoA, 20:3n-6-CoA, 20:4n-6-CoA, 20:5n-3-CoA, 22:5n-3-CoA.

Delta-5 Elongase (*Ostreococcus tauri*), c-d5Elo(Ot_GA3) Enzyme Activity: c-d5Elo(Ot_GA3) enzyme activity and substrate specificity can be demonstrated in microsomes isolated from a yeast strain expressing the c-d5Elo(Ot_GA3) protein using [^{14}C]malonyl-CoA and an acyl-CoA in the general elongase assay described above. Acyl-CoA's may include, but are not limited to: 18:1n-9-CoA, 18:2n-6-CoA, 18:3n-6-CoA, 20:3n-6-CoA, 20:4n-6-CoA, 20:5n-3-CoA, 22:5n-3-CoA.

In the presence of NADPH and [^{14}C]malonyl-CoA, 18:3n-6-CoA was elongated to 20:3 n-6-CoA by the delta-6 Elongases isolated from *Thalassiosira pseudonana* (Tp) and *Physcomitrella patens* (Pp) as shown if Figure 28, panels A and B. In both delta-6 elongase reactions the observed FAME-product co-migrates with 20:3n-6-methyl ester standards and was radioactive, consistent with transfer of two-carbons from [^{14}C]-malonyl-CoA to 18:3n-6-CoA. In the presence of NADPH the fatty acid reduction cycle was completed resulting in a saturated enzymatic product. However in the absence of NADPH a derivative of the direct enzymatic product, 3-keto-20:3n-6-CoA, was isolated as a FAME. The isolated enzymatic product was decarboxylated and converted to the 2-keto-19:3n-6-FAME as described previously (Bernert, J.T and Sprecher, H. (1977) J. Biol. Chem. 252:6736-6744 and Paul et al (2006) J. Biol. Chem. 281: 9018-9029). Appropriate controls demonstrate that this elongation reaction was dependent upon either the Delta-6 Elo (Tp) or the Delta-6 Elo (Pp) and not catalyzed by endogenous yeast enzymes.

In the presence of NADPH and [^{14}C]malonyl-CoA , 20:5n-3-CoA was elongated to 22:5 n-3-CoA by the c-d5Elo(Ot_GA3), and containing either an N-terminal FLAG tag or a C-terminal FLAG tag, as shown in Figure 28, panel C. In the Delta-5 elongase reaction the observed FAME-product co-migrates with a 22:5n-3-methyl ester standard and was radioactive, consistent with transfer of two-carbons from [^{14}C]-malonyl CoA to 20:5n-3-CoA. In the presence of NADPH the fatty acid reduction cycle was completed resulting in a saturated enzymatic product. However in the absence of NADPH a derivative of the direct 3-keto-22:5n-3-CoA product was isolated as a FAME. The isolated enzymatic product was decarboxylated and a 2-keto-21:5n-3-FAME as described previously (Bernert, J.T and Sprecher, H. (1977) J. Biol. Chem. 252:6736-6744 and Paul et al (2006) J. Biol. Chem. 281: 9018-9029). Appropriate controls demonstrate that this elongation reaction was dependent upon the Delta-5 Elo (Ot) and not catalyzed by endogenous yeast enzymes.

Herein, using a highly sensitive elongase assay, we have demonstrated the enzyme activities of the Delta-6 Elongases used (Figure 28, panel A and B) and a Delta-5 Elongase (Figure 28, panel C), enzymes that are central to engineering canola to biosynthesize docosahexaenoic acid. For each of these elongases we have shown that in the presence of [^{14}C]malonyl-CoA and the appropriate fatty-acyl CoA ester substrate these enzymes can transfer two-carbons (containing [^{14}C]) from malonyl-CoA to the appropriate fatty-acyl-CoA ester to synthesize a new fatty acid which has been elongated by two carbons. In some cases a derivative (decarboxylated 2-keto compound) of the direct enzymatic product (3-Keto-acylCoA ester) of the elongase was observed, however in the absence of NADPH only this decarboxylated 2-keto compound was observed, consistent with previous observations by Napier (Bernert, J.T and Sprecher, H. (1977) J. Biol. Chem. 252:6736-6744 and Paul et al (2006) J. Biol. Chem. 281: 9018-9029).

In summary we have provided a method that allows unequivocal demonstration of fatty acyl elongation enzyme activity. We provide data demonstrating that: (1) gene c-d6Elo(Tp_GA2) encodes a delta-6 elongase protein from *Thalassiosira pseudonana* (c-d6Elo(Tp_GA2)) that converts 18:3n-6-CoA to 20:3n-6-CoA in microsomes isolated from a transgenic yeast (Figure 28, panel A), (2) gene c-d6Elo(Pp_GA2) encodes a delta-6 elongase protein from *Physcomitrella patens* (c-d6Elo(Pp_GA2)) that converts 18:3n-6-CoA to 20:3n-6-CoA in microsomes isolated from a transgenic yeast (Figure 28, panel B), (3) a transgenic *B. napus* event containing both the gene encoding for the delta-6 elongase protein from *Thalassiosira pseudonana*, gene c-d6Elo(Tp_GA2), and the gene encoding for the gene the delta-6 elongase protein from *Physcomitrella patens*, gene c-d6Elo(Pp_GA2), contains at least one enzyme, localized to the microsomes, capable of elongating 18:3n-6-CoA to 20:3n-6-CoA (Figure 28, panel A) (4) gene c-d5-Elo(Ot_GA3) encodes a delta-5 elongase protein from *Ostreococcus tauri* (c-d5Elo(Ot_GA3)) that converts 20:5n-3-CoA to 22:5n-3-CoA in microsomes isolated from both a transgenic yeast (Figure 28, Panel C) and transgenic *B. napus* event (Figure 29, Panel B). In all examples presented no endogenous elongase activity was detected in microsomes isolated from either control yeast strains (Figure 28) or control Brassica lines (Figure 29).

Using the methods described in "Elongase Activity" for elongase proteins the level of expression or detected enzyme activity may be influenced by the presence or absence of fusion tags to the native protein. Fusion tags or proteins to the desaturases may be attached the amino-terminus

(N-terminal fusions) or the carboxy-terminus (C-terminal fusions) of the protein and may include but are not limited to: FLAG, hexa-Histidine, Maltose Binding Protein, and Chitin Binding Protein.

We have provided methods to establish enzyme catalyzed elongase reactions required in an engineered pathway to biosynthesize docosohexaenoic acid (DHA, 22:6n-3) from oleic acid (18:1n-9) in canola. The methods presented in Example 21 were developed to demonstrate elongase activity in yeast strains expressing individual elongases and can be further used to confirm the respective elongase enzyme activities in transgenic canola. Furthermore these methods can be incorporated, by one skilled in the art, to establish elongase enzyme activities in other organisms including, but not limited to: *Saccharomyces cerevisiae*, *Arabidopsis thaliana*, *Brassica* spp., *Camelina sativa*, *Carthamus tinctorius*, and *Salvia hispanica*.

Example 22: In vivo demonstration of mode of action: substrate specificity, substrate selectivity

Cloning of Genes into Yeast Expression Vectors:

For single gene expression, the yeast expression vector pYES2.1/V5-His-TOPO (Invitrogen) was used. Flanking primers were designed according to the manufacturer's instructions, and genes were amplified from plant expression vectors using the proof-reading polymerase Phusion high-fidelity polymerase (New England Biolabs). After agarose gel electrophoresis PCR fragments were cut out and purified using an EZ-10 spin column gel extraction kit (Bio Basic Inc.), cloned into the yeast expression vector pYES2.1/V5-His-TOPO (Invitrogen), transformed into *E. coli*, and gene orientation was checked by PCR. For co-expression of multiple genes, genes were cloned into pESC yeast expression vectors (Stratagene) under the control of the GAL1 promoter. To do this, appropriate restriction sites were introduced upstream and downstream of coding regions via PCR, followed by fragment isolation, TA-cloning into the pGEM-T vector, release of the gene fragment by enzyme digestion, and ligation into the pESC vector. For all constructs plasmids were isolated using an EZ-10 spin column plasmid DNA miniprep kit (Bio Basic Inc.). All constructs were sequenced prior to yeast transformation. After sequencing, plasmids were transformed into Saccharomyces cerevisiae (yeast) strain INVSc1 (Invitrogen), using the Sc EasyComp Transformation Kit (Invitrogen) according to the manufacturer's protocol, and selected on plates lacking the appropriate amino acids.

Expression of Heterologous Genes in Yeast:

Yeast cultures were grown overnight at 30°C in drop out base (DOB-URA: 1.7 g/L yeast nitrogen base, 5 g ammonium sulfate, and complete supplement mixture minus appropriate amino acids for selection) containing 2 % glucose. The OD600 of the overnight yeast cultures were obtained and culture concentrations were standardized between samples. The samples were washed with DOB-URA containing 2 % galactose and expression was carried out for 3 days at 20 °C in the same media supplemented with exogenous fatty acids and 0.01 % tergitol. For exogenous fatty acid feeding, cells were fed with 0.25 mM of the appropriate fatty acids, except where indicated otherwise. Fatty acid substrates and FAME standards were purchased from Nu-Chek Prep Inc (Elysian, MN).

Fatty Acid Analysis by Gas Chromatography:

5 mL cultures were precipitated by centrifugation and washed once with induction buffer and once with water. The supernatant was removed, and 2 mL of 3N methanolic-HCl (Supelco) was added to the cell pellet. After gentle mixing, the mixture was incubated at 80°C for 40 min, cooled to room temperature, and 1 mL 0.9% NaCl plus 2 mL hexane was added. The sample was vortexed and centrifuged, and the hexane phase was removed and dried under nitrogen gas. Fatty acid methyl esters (FAMEs) were resuspended in 100 µl hexane and analyzed by gas chromatography using an Agilent 6890N gas chromatograph equipped with a DB-23 column. The thermal program used was 160 °C for 1 min, then temperature was increased to 240 °C at a rate of 4 °C/min. FAMEs were identified based on known standards and the conversion percent was calculated as: [(Product)x100%]/(Substrate + Product).

Time Course Studies:

Samples were grown overnight at 30°C, sample concentrations were standardized prior to feeding, and cultures were induced at 20°C. For some time course studies, samples were pre-induced overnight prior to feeding as indicated in results. Samples (1 ml of culture) were collected at the indicated time intervals, washed once with 0.5% tergitol and once with double distilled water, and pellets were stored at -80°C until the completion of the time course. Fatty acid extraction and GC analysis basically followed methods described for "Fatty Acid Analysis by Gas Chromatography", however 1 mL methanolic HCl and 0.5 mL 0.9% NaCl and 1mL hexane were used for fatty acid extraction, and the final resuspension was performed in 100 µL hexane.

Feeding Studies with Individual Fatty Acids:

Samples were grown overnight at 30°C, sample concentrations were standardized prior to feeding, and cultures were induced at 20°C for 3 days. Measurements from at least 3 clones were used to calculate averages.

Feeding Studies with Multiple Fatty Acids:

Fatty acids for co-feeding were selected based on results from experiments described above where cells expressing each construct were fed with all possible substrates. The positive substrates for a given enzyme were fed together, however, if one substrate formed a product that also was a known substrate (for example, with certain elongases), separate mixtures were used. For omega-3-desaturases, two mixtures, each containing SDA as a standard, were used for feeding. Initially, cultures were fed mixtures containing 0.25 mM total fatty acid substrate. However, due to differences in uptake, it was necessary to optimize fatty acid mixtures so that the levels of Substrate A + Product A was equal to Substrate B + Product B within ± 5%. The final fatty acid mixtures used were also subjected to GC to obtain an estimation of relative uptake.
After appropriate fatty acid mixtures were obtained, induction and feeding was performed as described above (Expression of Heterologous Genes in Yeast). After induction, yeast cells were induced for 3 days at 20 °C before harvesting of cells and GC analysis as described above (Expression of Heterologous Genes in Yeast and Fatty Acid Analysis by Gas Chromatography). All experiments were replicated three times.

Co-expression Heterologous Genes in Yeast:

Protocols for co-expression of genes basically followed those provided for single gene expression experiments. Cultures were grow overnight at 30°C, sample concentrations were standardized prior to feeding, and cultures were induced at 20°C for 3 days. The following sets of genes were co-expressed (pY = pYES2.1/V5-His-TOPO ; pT= pESC-Typ, pL=pESC-Leu):
1) pY-c-d12Des(Ps_GA) /pT-c-d6Des(Pir_GA)
2) pY-c-d12Des(Ps_GA)/pT-c-d6Des(Ot_febit)
3) pY-c-d6Elo(Tp_GA2)/pT-c-d6Des(Ot_febit)
4) pY-c-d6Elo(Tp_GA2)/pT-c-d6Des(Pir_GA)
5) pL- c-d6Elo(Tp_GA2)/pY-c-d5Des(Tc_GA2)
6) pL-c-d8Des(Eg) /pY-c-d5Des(Tc_GA2)
7) pL- c-d6Elo(Tp_GA2)/pY-c-d5Des(Sa)
8) pL-c-d8Des(Eg)/pY-c-d5Des(Sa)

Isolation and Analysis of Lipids:
For expression of desaturases or elongases, yeast cultures were grown overnight at 30°C in drop out base (DOB-ura) containing 2% glucose. The samples were washed with induction media (DOB-ura) containing 2% galactose and expression was induced for 3 days at 20 °C in the same media supplemented with the appropriate fatty acids and 0.01 % tergitol (NP-40). After 3 days of incubation, yeast cells were collected by centrifugation and washed twice with distilled water. Fifteen mL of chloroform:methanol (1:1) was added to the collected yeast pellet and the sample was incubated at room temperature with shaking for 3 hr. After the 3 hr incubation, the sample was centrifuged and the aqueous phase was collected and stored at -20°C. Chloroform:methanol (2:1) was added to the pellet, and it was incubated overnight at 4°C, then subjected to centrifugation. The aqueous phase was collected and pooled with the aqueous phase collected previously. Nine mL of 0.45% NaCl was added to the pooled aqueous phase, the sample was vortexed and the organic phase was collected after separated by centrifugation at 1500 x g for 3 min. The organic phase was dried under nitrogen gas and resuspended in 100 uL of chloroform to give the total fatty acid fraction. 5 uL of the total fatty acid fraction was analyzed by GC, and the remainder was separated by TLC as described below.
TLC plates were heat activated for at least 3 hrs at 120°C before use. The mobile phase used to separate the fatty acids consisted of chloroform : methanol : acetic acid (65:35:8) and primuline (5mg in 100mL acetone : water, 80:20) was used to visualize the separated lipid fractions under UV light. The individual lipid fractions (PC, PE, PI+PS, and neutral lipids) were identified using standards and removed separately from the TLC plate. To extract the lipids from the silica, 400 uL water, 2 mL chloroform and 2 mL methanol were added, the sample was vortexed vigorously, and 2 mL of 0.2 M H_3PO_4/ 1M KCl was added. The lower organic phase was collected and the remaining aqueous phase was re-extracted by adding 2 mL of chloroform. The pooled organic phase was dry under nitrogen gas, and the fatty acid profile of individual lipid fractions was analyzed by gas chromatography. GC was performed by adding 2 mL of 3N methanolic HCl, followed by incubation at 80 °C for 40 min, then adding 1 ml of 0.9% NaCl and 2 mL of hexane and vortexing. The hexane phase was collected, dried under nitrogen gas, and resuspended in 100 µL of hexane for GC analysis. Gas chromatography was performed using an Agilent 6890N gas chromatograph equipped with a DB-23 column and a thermal program consisting of: 160 °C

for 1 min, then temperature was increased to 240 °C at a rate of 4 °C/min. After the initial GC analysis, samples with low concentrations were re-suspended in 40µL of hexane and re-analyzed.

Time Course studies:

Initially, a range of conditions were tested with the c-d5Des(Tc_GA2) (Figure 30). When cultures were fed with 0.25 mM exogenous substrate at the beginning of induction the amounts of product and substrate and the desaturation percentage remained steady from approximately 48-92 hours (Figure 30, Panel A). Therefore, these conditions were used for further time course experiments.

To determine if these conditions were acceptable for all gene constructs, time courses were conducted with yeast cultures expressing all 10 genes individually. The preferred substrate for each enzyme was supplied exogenously (Figure 31).

Although the rate of uptake of fatty acids and the activity of enzymes varied, the levels of product, substrate and percent elongation or desaturation was relatively stable at the 72 hour time point (Figure 31). Therefore data collection at 72 hours was used in all further experiments, except where noted otherwise.

Analysis of all enzymes with all fatty acids:

The major activity of each desaturase and elongase used in the plant construct was determined upon gene isolation. However, many desaturases and elongases have secondary activities. When all enzymes are present together, such secondary activities affect the overall production rates of desired fatty acids, or lead to the production of side-products. In this experiment, we tested all enzymes with all fatty acids that might be expected to be present in a plant expressing all 10 genes. The enzymes and fatty acids used in this experiment are listed below:

Enzyme	Fatty acid
c-d12Des(Ps_GA)	18:1n-9
c-d6Des(Ot_febit)	LA (18:2n-6)
c-d6Elo(Pp_GA2)	ALA (18:3n-3)
c-d6Elo(Tp_GA2)	GLA (18:3n-6)
c-d5Des(Tc_GA2)	SDA (18:4n-3)
c-o3Des(Pi_GA2)	DHGLA (20:3n-6)
c-o3Des(Pir_GA)	ETA (20:4n-3)
c-d5Elo(Ot_GA3)	ARA (20:4n-6)
c-d4Des(Pl_GA)2	DTA (22:4n-6)
c-d4Des(Tc_GA)	DPAn-3 (22:5n-3)
	DPAn-6 (22:5n-6)

DHAn-3 (22:6n-3)

Although each individual substrate fatty acid was tested with each individual enzyme, results are only given for fatty acid/enzyme combinations where a detectable level of activity was obtained (see Table 159, Table 160, and Table 161).

Although we saw some side activities with the desaturases, such as the conversion of GLA to SDA by the c-d5Des(Tc_GA2) and conversion of DHGLA to ARA by the c-d4Des(Tc_GA), these activity levels were low and produce fatty acids that would be expected in the DHA synthesis pathway (Table 159).

We also analyzed the substrate profile of single point mutants of c-d12Des(Ps_GA) and c-d4Des(Pl_GA)2. The single nucleotide change leading to the F83L mutation in c-d12Des(Ps_GA) did not lead to any significant change in either the substrate preference or efficiency of desaturation relative to the wild-type version of c-d12Des(Ps_GA) (data shown in Table 159). Similarly, a single nucleotide change leading to the A102S mutation in d4Des(Pl_GA)2) did not lead to any significant change in either the substrate preference or efficiency of desaturation relative to the wild-type version of d4Des(Pl_GA)2 (data shown in Table 159).

Table 159. Conversion percentages of exogenous fatty acids by desaturases.

Enzyme	Substrate	Product	% desaturation
c-o3Des(Pir_GA)	GLA	SDA	2.7 ± 0.05
	DPAn-6	DHAn-6	6.93 ± 0.85
	ARA	EPA	45.44 ± 2.40
	LA	ALA	6.29 ± 0.28
	DTA	DPAn-3	25.57 ± 1.16
	DHGLA	ETA	31.64 ± 3.38
c-o3Des(Pi_GA2)	GLA	SDA	7.84 ± 0.53
	DPAn-6	DHAn-3	4.77 ± 0.78
	ARA	EPA	40.0 ± 3.38

Enzyme	Substrate	Product	% desaturation
	LA	ALA	5.47 ± 0.76
	DTA	DPAn-3	17.86 ± 0.43
	DHGLA	ETA	39.71 ± 2.37
c-d5Des(Tc_GA2)	DHGLA	ARA	58.03 ± 2.01
	GLA	SDA	0.23 ± 006
c-d4Des(Tc_GA)	DPAn-3	DHAn-3	20.74 ± 1.43
	DTA	DPAn-6	17.33 ± 0.24
	DHGLA	ARA	1.15 ± 0.12
c-d4Des(Pl_GA)2	DPAn-3	DHAn-3	43.78 ± 3.85
	DTA	DPAn-6	44.26 ± 4.83
c-d12Des(Ps_GA)	18:1	LA	57.04 ± 0.49
	16:1*	16:2	32.42 ± 0.64
c-d6Des(Ot_febit)	LA	GLA	68.82 ± 1.89
	ALA	SDA	71.0 ± 0.68

The elongases generally showed a higher level of side activities (Table 160, Table 161). While the two delta-6 elongases showed similar conversion percentages for the main substrates GLA and SDA, the P. patens enzyme showed higher levels of activity on LA and ALA, and only the P. patens delta-6 elongases showed detectable activity of ARA and EPA. Nonetheless, activity levels were substantially higher with GLA and SDA, suggesting that if these fatty acids, which were expected to be available in the pathway, would be the preferred substrate of the enzyme.

Table 160. Conversion percentages of exogenous fatty acids by Delta-6 Elongases

Enzyme	Substrate	Product	% Elongation
c-d6Elo(Pp_GA2)	GLA	DHGLA	80.23 ± 0.81
	SDA	20:4n-3	85.67 ± 1.18
	LA	20:2n-6	20.86 ± 1.23
	ALA	20:3n-3	31.19 ± 0.23
	ARA	DTA	2.42 ± 0.08
	EPA	DPAn-3	5.16 ± 0.29
c-d6Elo(Tp_GA2)	GLA	DHGLA	70.11 ± 1.37
	SDA	20:4n-3	85.55 ± 0.32
	LA	20:2n-6	2.22 ± 0.15
	ALA	20:3n-3	4.63 ± 0.35

The c-d5Elo(Ot_GA3) was capable of consecutive elongations of most fatty acids (Table 161). However, the highest conversion by a large margin was for the desired EPA to DPAn-3 conversion. In the engineered plant system, the two delta-4 desaturases are available to desaturate DPAn-3, preventing further elongation. The levels of fatty acids containing 24 carbons produced by this elongase are small given that high levels of substrate are present in the yeast system and no competing enzymes are present.

Table 161. Conversion percentages of exogenous fatty acids by c-d5Elo(Ot_GA3) elongase. Substrate and Product values represent % of total fatty acids.

Substrate	Product 1	Product 2	Product 3	% Elongation
LA	**20:2n-6**			
24.34 ± 1.28	0.41 ± 0.07			1.64 ± 0.18
DHGLA	**22:3n-6**			
12.92 ± 0.93	1.24 ± 0.22			8.73 ± 1.10
DHAn-3	**24:6n-3**			
9.41 ± 0.86	1.37 ± 0.12			12.84 ± 1.84
DPAn-3	**24:5n-3**			
10.85 ± 0.46	2.15 ± 0.28			16.59 ± 2.37
GLA	**DHGLA**	**22:3n-6**		
23.95 ± 3.22	1.0 ± 0.13	0.24 ± 0.03		4.91 ± 0.24
ARA	**22:4n-6**	**24:4n-6**		
7.12 ± 1.33	11.23 ± 0.28	0.26 ± 0.05		61.92 ± 5.22
EPA	**DPAn-3**	**24:5n-3**		
0.85 ± 0.01	6.76 ± 0.85	1.74 ± 0.21		90.8 ± 0.98
SDA	**20:4n-3**	**22:4n-3**	**24:4n-3**	
14.42 ± 1.18	0.47 ± 0.04	4.17 ± 0.12	0.26 ± 0.03	25.48 ± 1.72
ALA	**20:3n-3**	**22:3n-3**	**24:3n-3**	
20.09 ± 3.23	1.79 ± 0.28	1.70 ± 0.35	0.15 ± 0.03	15.38 ± 2.06

Since 20:4n-3 was not commercially available it was generated in vivo by co-expression of c-d6Elo(Tp_GA2) with each of the other desaturases or elongases. Therefore upon supplying exogenous SDA, 20:4n-3 was produced by the c-d6Elo(Tp_GA2) and the efficiency of conversion of this fatty acid by the second enzyme was measured.

Table 162. Enzyme activity with 20:4n-3.

Helper Enzyme (delta-6 elongase) pL vector	2nd enzyme in pY vector	delta-6 elongase conversion efficiency (%)	Conversion efficiency of 2nd enzyme (%)	Gene dosage effect
c-d6Elo(Tp_GA2)	c-d4Des(Pl_GA)2	70.0 ± 1.2	N/A	N/A
c-d6Elo(Tp_GA2)	c-d4Des(Tc_GA)	69.1 ± 0.7	3.3 ± 0.2	N/A

Helper Enzyme (delta-6 elongase) pL vector	2nd enzyme in pY vector	delta-6 elongase conversion efficiency (%)	Conversion efficiency of 2nd enzyme (%)	Gene dosage effect
c-d6Elo(Tp_GA2)	c-d5Des(Tc_GA2)	64.3 ± 1.4	86.2 ± 1.0	N/A
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	72.9 ± 2.1	2.9 ± 0.2	N/A
c-d6Elo(Tp_GA2)	c-d12Des(Ps_GA)	70.3 ± 1.3	N/A	N/A
c-d6Elo(Tp_GA2)	c-o3Des(Pi_GA2)	67.4 ± 3.6	N/A	N/A
c-d6Elo(Tp_GA2)	c-o3Des(Pir_GA)	70.0 ± 1.1	N/A	N/A
c-d6Elo(Tp_GA2)	c-d5Elo(Ot_GA3)	68.8 ± 1.4	80.2 ± 2.5	N/A
c-d6Elo(Tp_GA2)	c-d6Elo(Pp_GA2)	89.8 ± 0.7	N/A	YES (Δ6 ELO)
c-d6Elo(Tp_GA2)	c-d6Elo(Tp_GA2)	90.3 ± 0.8	N/A	YES (Δ6 ELO)

* Cultures were fed with SDA and 20:4n-3 (delta-6 elongation) was produced as a substrate for either desaturases or elongases. Three repeats were measured. pY: pYES2.1/V5-His-TOPO expression vector; pL: pESC-Leu expression vector. All genes were placed under the control of the Gal1 promoter. N/A: not applicable; DES: desaturase; ELO: elongase

The c-d4Des(Tc_GA), the c-d5Des(Tc_GA2), the c-d6Des(Ot_febit), and the c-d5Elo(Ot_GA3) were able to use 20:4n-3 as a substrate (Table 162). The c-d5Des(Tc_GA2) showed the highest conversion percentage, which would be expected as 20:4n-3 was a known substrate for delta-5 desaturases. The c-d5Elo(Ot_GA3) was also able to efficiently produce 22:4n-3. When using two delta-6 elongases in one construct, a gene dosage effect was observed; the delta-6 elongase activity increased in the presence of two c-d6Elo(Tp_GA2), or a gene pair consisting of a c-d6Elo(Tp_GA2) and a c-d6Elo(Pp_GA2).

Fatty acid specificity of desaturases and elongases of this invention

Enzymes were provided with mixtures of fatty acids to allow comparisons of relative activity when two substrates were present concurrently; an enzyme may be more active on substrate A than substrate B when they are supplied individually, but when they are supplied at the same time the relative activity of the enzyme on each substrate could change. Fatty acids of the same length were preferably provided at the same time, since they would be most likely to be present in the plant concurrently. Mixtures of fatty acids were adjusted so that the level of (substrate 1 + product 1) = (substrate 2 + product 2) within ± 5%.

Table 163. Fatty acid preferences of elongases and desaturases

Gene (Fatty Acid Mix)	Substrate	% conversion
c-d5Elo(Ot_GA3) (EPA/ARA/DHGLA)	EPA	90.36 ± 2.17
	ARA	40.96 ± 4.50
	DHGLA	3.14 ± 0.47
c-d5Elo(Ot_GA3) (DPAn-3/DHA)	DPAn-3	4.75 ± 0.57
	DHA	5.69 ± 0.56

Gene (Fatty Acid Mix)	Substrate	% conversion
c-d5Elo(Ot_GA3) (LA/ALA)	LA ALA	0.57 ± 0.06 13.43 ± 1.65
c-d5Elo(Ot_GA3) (GLA/SDA)	GLA SDA	2.89 ± 0.06 29.24 ± 0.73
c-d4-Des(Tc_GA) (DTA/DPAn-3)	DTA DPAn-3	21.01 ± 2.28 25.18 ± 2.08
c-d4-Des(Pl_GA)2 (DTA/DPAn-3)	DTA DPAn-3	34.41 ± 1.63 41.27 ± 2.07
c-d6-Des(Ot_febit) (LA/ALA)	LA ALA	56.62 ± 2.06 77.66 ± 0.80
c-d6-Elo(Pp_GA2) (LA/ALA)	LA ALA	11.38 ± 0.94 24.41 ± 1.84
c-d6-Elo(Pp_GA2) (GLA/SDA)	GLA SDA	81.59 ± 1.66 85.23 ± 1.28
c-d6-Elo(Tp_GA2) (LA/ALA)	LA ALA	1.93 ± 0.15 6.41 ± 0.68
c-d6-Elo(Tp_GA2) (GLA/SDA)	GLA SDA	81.61 ± 1.03 87.70 ± 0.87
c-d5-Des(Tc_GA2) (DHGLA/ETA)	DHGLA ETA (20:4n-3)	85.0 ± 2.38 90.75 ± 1.15
c-o3-Des(Pi_GA2) (DHGLA/ARA/DTA)	DHGLA ARA DTA	28.82 ± 1.26 39.15 ± 1.19 7.32 ± 0.63
c-o3Des(Pir_GA) (DHGLA/ARA/DTA)	DHGLA ARA DTA	25.22 ± 1.70 53.19 ± 2.52 12.66 ± 1.17

As described in Table 163 the relative activities of the omega-3 desaturases follow the same order as described earlier (Table 159), but that the activity of both omega-3 desaturases was lower on DTA when DHGLA and ARA were available. Both delta-4 desaturases showed a preference for the omega-3 substrate when the omega-3 and omega-6 substrates were present in equal amounts. The preference of the c-d6Des(Ot_febit) for the omega-3 substrate was also increased when both substrates are available (Table 163). For the delta-5 elongase, the relative elongation of secondary substrates generally dropped when the primary, or preferred substrate was available (Table 163).

Additive enzyme activity supporting MoA (CoA vs PC)

The delta-5 desaturase genes from *S. arctica* and *Thraustochytrium* sp. were cloned into the pYES2.1/V5-His-TOPO expression vector, and both the c-d6Elo(Tp_GA2) and the c-d8Des(Eg) were cloned into the pESC-Leu expression vector. Yeast was transformed with the appropriate vector pairs and selection on DOB-uracil-leucine. Positive cultures were grown and induced and GC analysis was conducted as described above in Example 23. All cultures were grown concurrently.

Table 164. Deduced mode of action of the Delta-5 desaturases.

Helper Enyzme known to work in PC (delta-8 DES)	**delta-5 DES**	**delta-% DES Conversion efficiency**	**Deduced MoA of delta-5 DES**
c-d8Des(Eg)	c-d5Des(Sa)	38 %	
c-d8Des(Eg)	c-d5Des(Tc_GA2)	36 %	
Helper Enyzme known to work in CoA (delta-6 ELO)	**delta-5 DES**	**delta-% DES Conversion efficiency**	
c-d6Elo(Tp_GA2)	c-d5Des(Sa)	32 %	PC
c-d6Elo(Tp_GA2)	c-d5Des(Tc_GA2)	80 %	CoA

As described in Table 164, the delta-5 desaturase activity of the c-d5Des(Sa) on DHGLA was similar regardless if the DHGLA was derived from elongation in the coenzyme A (CoA) pool or desaturation in the phosphatidylcholine (PC) pool. Conversely, Table 164 also shows that the delta-5 desaturase activity of the c-d5Des(Tc_GA2) was much higher if the DHGLA substrate was derived from elongation in the CoA pool. In combination with data from lipid analysis by TLC, this suggests that the c-d5Des(Tc_GA2) was capable of desaturating substrates in the CoA pool, although it does not indicate that desaturation was limited to this pool.

The level of delta-6-elongation following desaturation by a desaturase active in the PC pool (c-d6Des(Pir_GA)) and a desaturase thought to be active in the CoA pool (c-d6Des(Ot_febit)) was determined. Since elongation takes place in the acyl-CoA pool, more efficient elongation can occur following desaturation by an acyl-CoA dependent desaturase. The two desaturases were also expressed in the presence of a delta -12 desaturase that was active on PC substrates, to allow the efficiency of subsequent delta -6 desaturation to be compared. Finally, the effects of individual desaturase genes and pairs of desaturase genes on elongase and desaturase activity were compared to determine dosage effects.

Table 165. Effects of various delta-6 desaturases on subsequent delta-6 elongation*.

Construct	delta- 6 Des %	delta- 6 ELO %
pT-c-d6Des(Ot_febit) & pY-c-d6Elo(Tp_GA2)	44.9 ± 1.0	89.3 ± 1.4
pT-c-d6Des(Pir_GA) & pY-c-d6Elo(Tp_GA2)	19.7 ± 0.5	63.7 ± 4.8

* Cultures were fed with LA and production of GLA (delta-6 desaturation) and DHGLA (delta-6 elongation) were measured. pY: pYES2.1/V5-His-TOPO expression vector pT: pESC-trp expression vector. All genes were under the control of the Gal1 promoter.

Table 166. Effects of delta-12 desaturation on subsequent delta-6 elongation*.

Construct	delta-12 DES %	delta-6 DES %
pT-c-d6Des(Ot_febit) & pY-c-d12Des(Ps_GA)	60.2 ± 2.9	23.2 ± 0.1
pT-c-d6Des(Pir_GA) & pY-c-d12Des(Ps_GA)	62.8 ± 1.4	17.1 ± 1.7

* Cultures were supplied with exogenous 18:1n-9. The production of LA (delta-12 desaturation) and GLA (delta-6 desaturation) were measured. pY: pYES2.1/V5-His-TOPO expression vector pT: pESC-trp expression vector. All genes were under the control of the Gal1 promoter.

GLA conversion by the c-d6Elo(Tp_GA2) was higher with GLA derived from desaturation by the c-d6Des(Ot_febit) compared to GLA derived by desaturation with the c-d6Des(Pir_GA) (Table 165). This shows that c-d6Des(Ot_febit) acts in the acyl-CoA pool, making the resulting substrate more readily available for the delta-6 elongase, and therefore resulting in a higher elongase activity. Correspondingly, the delta-6 desaturase activity of the c-d6Des(Ot_febit) was reduced by almost half if the substrate was derived from delta-12 desaturation in the PC pool (Table 165 and Table 166), whereas the the delta-6 desaturase activity of the c-d6Des(Pir_GA) was similar whether the substrate (LA) was derived from delta-12-desaturation of OA in the PC pool, or was supplied exogenously (Table 165 and Table 166). Exogenously supplied substrate was believed to enter the yeast cell in the form of acyl-CoA. In combination with data from lipid analysis by TLC, this data suggests that the c-d6Des(Ot_febit) was acyl-CoA-dependent enzyme, consistent with a previous prediction (Domergue et al. (2005) Biochem. J. 389: 483-490).

Table 167. Effect of substrate pool and gene dosage on delta-6-desaturation and subsequent delta-6-elongation of ALA.

Helper Enzyme (delta-6 elongase) pL vector	First delta-6 desaturase pY vector	Second delta-6 desaturase pT vector	delta-6 desaturase conversion efficiency	delta-6 elongase conversion efficiency	Gene dosage effect	Deduced MoA of 1st delta-6 desaturase	Deduced MoA of 2nd delta-6 desaturase
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	pT vector	64.3 ± 1.5	73.3 ± 0.2	N/A	CoA	N/A
c-d6Elo(Tp_GA2)	c-d6Des(Pir_GA)	pT vector	26.8 ± 11.0	53.0 ± 8.8	N/A	PC	N/A
c-d6Elo(Tp_GA2)	pY vector	c-d6Des(Ot_febit)	60.8 ± 2.3	80.8 ± 0.6	N/A	N/A	CoA
c-d6Elo(Tp_GA2)	pY vector	c-d6Des(Pir_GA)	27.9 ± 0.9	52.0 ± 0.9	N/A	N/A	PC
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	c-d6Des(Pir_GA)	72.5 ± 2.2	71.1 ± 2.1	Yes (DES)	CoA	PC
c-d6Elo(Tp_GA2)	c-d6Des(Pir_GA)	c-d6Des(Pir_GA)	40.5 ± 1.3	47.5 ± 2.0	Yes (DES)	PC	PC
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	c-d6Des(Ot_febit)	72.4 ± 0.9	78.1 ± 0.7	Yes (DES)	CoA	CoA

* Cultures were fed with ALA and production of SDA (delta-6 desaturation) and 20:4n-3 (delta-6 elongation) was measured. pY: pYES2.1/V5-His-TOPO expression vector; pL: pESC-Leu expression vector; pT: PESC-trp. All regulated by Gal1 promoter. N/A: not applicable; DES: desaturation conversion percent. Data from at least 3 clones were used for each measurement.

Table 168. Effect of substrate pool and gene dosage on delta-6-desaturation and subsequent delta-6-elongation of LA.

Helper Enzyme (delta-6 elongase) pL vector	First delta-6 desaturase pY vector	Second delta-6 desaturase pT vector	delta-6 desaturase conversion efficiency	delta-6 elongase conversion efficiency	Gene dosage effect	Deduced MoA of 1st delta-6 desaturase	Deduced MoA of 2nd delta-6 desaturase
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	pT vector	60.3 ± 7.0	65.6 ± 1.8	N/A	CoA	N/A
c-d6Elo(Tp_GA2)	c-d6Des(Pir_GA)	pT vector	23.4 ± 15.5	43.2 ± 8.6	N/A	PC	N/A
c-d6Elo(Tp_GA2)	pY vector	c-d6Des(Ot_febit)	48.5 ± 0.2	75.6 ± 1.5	N/A	N/A	CoA
c-d6Elo(Tp_GA2)	pY vector	c-d6Des(Pir_GA)	23.0 ± 0.8	36.9 ± 2.2	N/A	N/A	PC
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	c-d6Des(Pir_GA)	3.0 ± 1.4	60.1 ± 1.9	Yes (DES)	CoA	PC
c-d6Elo(Tp_GA2)	c-d6Des(Pir_GA)	c-d6Des(Pir_GA)	35.1 ± 2.2	35.4 ± 4.8	Yes (DES)	PC	PC
c-d6Elo(Tp_GA2)	c-d6Des(Ot_febit)	c-d6Des(Ot_febit)	62.5 ± 1.4	66.8 ± 2.5	Yes (DES)	CoA	CoA

* Cultures were fed with LA and production of GLA (delta-6 desaturation) and DHGLA (delta-6 elongation), three repeats were measured. pY: pYES2.1/V5-His-TOPO expression vector; pL: pESC-Leu expression vector; pT: PESC-trp. All genes were placed under the control of the Gal1 promoter. N/A: not applicable; DES: desaturation conversion percent.

When co-expressing the c-d6Elo(Tp_GA2) and the c-d6Des(Ot_febit) (CoA), a higher elongase conversion efficiency was achieved compared to co-expressing the c-d6Elo(Tp_GA2) and the c-d6Des(Pir_GA) (PC), regardless of whether n-3 or omega-6 substrate was supplied exogenously (Table 167, Table 168). This was observed whether the relevant desaturase gene was cloned into the pYes vector or the pESC-trp vector. A slight increase in desaturation efficiency was observed in the presence of two desaturase genes, particularly in cultures supplied with the omega-3 substrate ALA. Compared to cultures carrying a single c-d6Des(Ot_febit), the proportion of substrate elongated was only slightly enhanced in the presence of two acyl-CoA dependent cd6Des(Ot_febit), or in the presence of both desaturases. Co-expression of the c-d6Elo(Tp_GA2) with two copies of c-d6Des(Pir_GA) (PC) resulted in the lowest elongation conversion level among the cultures carrying two desaturases. The presence of the with acyl-CoA dependent delta-6 desaturase contributed to a higher delta-6 elongation activity whether it was expressed alone or along with a second desaturase, further indicating the usefulness of this gene for VLC-PUFA synthesis.

The effect of substrate pool for various delta-4 desaturases was determined in the presence of a helper enzyme, the c-d5Elo(Ot_GA3), which was known to work in the CoA pool. The gene dosage effect of delta-4 desaturase genes was also determined.

Table 169. Effect of substrate pool and gene dosage effect for delta-4 desaturases (exogenous EPA supplied).

Helper Enzyme (delta-5 elongase) pL vector	First delta-4 desaturase pY vector	Second delta-4 desaturase pT vector	delta-4 desaturase conversion efficiency	Gene dosage effect	Deduced MoA of 1st delta-4 desaturase	Deduced MoA of 2nd delta-4 desaturase
c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	pT vector	29.9 ± 4.0	N/A	CoA	NA
c-d5Elo(Ot_GA3)	c-d4Des(Tc_GA)	pT vector	31.2 ± 2.8	N/A	PC	NA
c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	c-d4Des(Tc_GA)	53.6 ± 1.0	++ (0.88)	CoA	PC
c-d5Elo(Ot_GA3)	c-d4Des(Eg)	c-d4Des(Tc_GA)	36.9 ± 3.5	Yes	PC	PC
c-d5Elo(Ot_GA3)	c-d4Des(Tc_GA)	c-d4Des(Tc_GA)	40.2 ± 0.2	+ (0.64)	PC	PC

* Cultures were fed with EPA and production of DPA (delta-5 elongation) and DHA (delta-4 desaturation) was measured for at least three samples. pY: pYES2.1/V5-His-TOPO expression vector; pL: pESC-Leu expression vector; pT: PESC-trp. All genes were placed under the control of the Gal1 promoter. N/A: not applicable. Dosage effect: number in brackets = conversion efficiency of two-desaturase construct/ (conversion efficiency of single gene A construct + conversion efficiency of single gene B construct).

Table 170. Effect of substrate pool and gene dosage effect for delta-4 desaturases (exogenous ARA supplied).

Helper Enzyme (delta-5 elongase) pL vector	First delta-4 desaturase pY vector	Second delta-4 desaturase pT vector	delta-4 desaturase conversion efficiency	Gene dosage effect	Deduced MoA of 1st delta-4 desaturase	Deduced MoA of 2nd delta-4 desaturase
c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	pT vector	28.8 ± 1.0	N/A	CoA	N/A
c-d5Elo(Ot_GA3)	c-d4Des(Tc_GA)	pT vector	27.0 ± 2.5	N/A	PC	N/A
c-d5Elo(Ot_GA3)	c-d4Des(Pl_GA)2	c-d4Des(Tc_GA)	44.0 ± 0.9	++ (0.79)	CoA	PC
c-d5Elo(Ot_GA3)	c-d4Des(Eg)	c-d4Des(Tc_GA)	29.4 ± 0.6	-	PC	PC
c-d5Elo(Ot_GA3)	c-d4Des(Tc_GA)	c-d4Des(Tc_GA)	32.2 ± 0.8	-	PC	PC

*Cultures were fed with ARA and production of DTA (delta-5 elongation) and DPAn-6 (delta-4 desaturation) were measured. pY: pYES2.1/V5-His-TOPO expression vector; pL: pESC-Leu expression vector; pT: PESC-Trp expression vector. All genes were placed under control of the Gal1 promoter. N/A: not applicable. Dosage effect: number in brackets = conversion efficiency of two-desaturase construct/ (conversion efficiency of single gene A construct + conversion efficiency of single gene B construct).

The desaturation levels achieved by the *P. lutheri* and c-d4Des(Tc_GA)s were similar. When two delta-4 desaturases were used, a significant gene dosage effects only observed with the *P. lutheri/Thraustochyrium* sp. pair, and the lowest with two copies of the *Thraustocytrium* sp desaturase. These trends were observed in the presence of elongated ARA (Table 170) and EPA (Table 169). However, with the n-6 elongation substrate (ARA), the desaturation conversion percentage was generally slightly lower compared to the omega-3 substrate (EPA).

Example 23: Spacer Regions Containing Transcription Factor Binding Motifs

As indicated in examples 3 and 4, between each expression cassette in the constructs used in the invention there is a spacer region of 100-200 base pairs. For the BiBAC T-DNAs, the short stretches of sequence in between the gene cassettes, which had been multi-cloning sites and Gateway site sequences in the co-transformation vectors, were subjected to randomization to maintain the GC content and to remove multiple repeats of identical sequence. The skilled worker would recognize that the presence of multiple repeats within a construct, in particular large multi-gene constructs, could result in internal deletions and rearrangements as the plasmid was cloned into *Escherichia coli* and passaged through the *Agrobacterium* strain/species used. After removal of repeats and adjustment of GC content, the sequences of the spacer regions were then examined for any possible binding sites for transcription factors and other DNA interacting proteins. The spacer region sequences used are RTP10690_1 through RTP10690_12, including the AtAHAS promoter and terminator, RTP10690_5', LJB2197_5' and LJB2197_1 through LJB2197_4. The underscore numbers also represent the order in which that spacer region appears in the cassette reading from the right border towards the left border, in the sense orientation of the GOI in the proceeding cassette. For example, RTP10690_1 was the sequence after the terminator of the first cassette and before the promoter of the second cassette in the construct VC-RTP10690-1qcz_F. The terminator of the AHAS selection cassette and the 5' region of the first cassette were also examined.

>RTP10690_1
TTAATTCAGCTAGCTAGCCTCAGCTGACGTTACGTAACGCTAGGTAGCGTCACGTGACGTT
AGCTAACGCTAGGTAGCGTCAGCTGAGCTTACGTAAGCGCTTAGCAGATATTT

>RTP10690_2
TTACTGATTGTCTACGTAGGCTCAGCTGAGCTTACCTAAGGCTACGTAGGCTCACGTGACG
TTACGTAAGGCTACGTAGCGTCACGTGAGCTTACCTAACTCTAGCTAGCCTCACGTGACCT
TAGCTAACACTAGGTAGCGTCAGCTCGACGGCCCG

>RTP10690_3
GGCGGAGTGGGGCTACGTAGCGTCACGTGACGTTACCTAAGCCTAGGTAGCCTCAGCTGA
CGTTACGTAACGCTAGGTAGGCTCAGCTGACACGGGCAGGACATAG

>RTP10690_4
GAATGAAACCGATCTACGTAGGCTCAGCTGAGCTTAGCTAAGCCTACCTAGCCTCACGTGA
GATTATGTAAGGCTAGGTAGCGTCACGTGACGTTACCTAACACTAGCTAGCGTCAGCTGAG
CTTAGCTAACCCTACGTAGCCTCACGTGAGCTTACCTAACGCTACGTAGCCTCACGTGACT
AAGGATGACCTACCCATTCTT

>RTP10690_5
GCGGCCGCTAGCTAGCCTCAGCTGACGTTACGTAACGCTAGGTAGCGTCACGTGACGTTA
GCTAACGCTAGGTAGCGTCAGCTGAGCTTACGTAAGCGCCACGGGCAGGACATAGGGACT
ACTACAA

>RTP10690_6
CGAATGAAACCGATCTACGTAGGCTCAGCTGAGCTTACCTAAGGCTACGTAGGCTCACGT
GACGTTACGTAAGGCTACGTAGCGTCACGTGAGCTTACCTAACTCTAGCTAGCCTCACGTG
ACCTTAGCTAACACTAGGTAGCGTCAGCTTAGCAGATAT

>RTP10690_7
CCGTTCAATTTACTGATTGTCTACGTAGCGTCACCTGACGTTACGTAAGGCTACCTAGGCT
CACGTGACGTTACGTAACGCTACGTAGCGTCAGGTGAGGTTAGCTAACGCTAGCTAGCCT
CACCTGACGTTAGGTAAGGCTACGTAGCGTCACCTGAGATTAGCTAAGCCTACCTAGACTC
ACGTGACCTTAGGTAACGCTACGTAGCGTCAAAGCTTTACAACGCTACACAAA

>RTP10690_8
TTACCTAACTTAGAACTAAAATCAACTCTTTGTGACGCGTCTACCTAGAGTCAGCTGAGCTT
AGCTAACGCTAGCTAGTGTCAGCTGACGTTACGTAAGGCTAACTAGCGTCACGTGACCTTA
CGTAACGCTACGTAGGCTCAGCTGAGCTTAGCTAACCCTAGCTAGTGTCACGTGAGCTTAC
GCTACTATAGAAAATGTGTTATAT

>RTP10690_9
TTCAGTCTAAAACAACTACGTAGCGTCACGTGACGTTACCTAAGCCTAGGTAGCCTCAGCT
GACGTTACGTAACGCTAGGTAGGCTCAGCTGACTGCAGCAAATTTACACATTGCCA

>RTP10690_10
TAATTCGGCGTTAATTCAGCTACGTAGGCTCAGCTGAGCTTACCTAAGGCTACGTAGGCTC
ACGTGACGTTACGTAAGGCTACGTAGCGTCACGTGAGCTTACCTAACTCTAGCTAGCCTCA
CGTGACCTTAGCTAACACTAGGTAGCGTCAGCACAGATGAATACTAGCTGTTGTTCA

>RTP10690_11
ATCATGATGCTTCTCTGAGCCGTGTTTGCTAGCTAGCCTCAGCTGACGTTACGTAACGCTA
GGTAGCGTCACGTGACGTTAGCTAACGCTAGGTAGCGTCAGCTGAGCTTACGTAAGCGCA
CAGATGAATACTAGCTGTTGTTCACA

>RTP10690_12
CTTCTCTGAGCCGTGTTTGCTAGCTAGCCTCAGCTGACGTTACGTAACGCTAGGTAGCGTC
ACGTGACGTTAGCTAACGCTAGGTAGCGTCAGCTGAGCTTACGTAAGCGCTTAATTAAAGT
ACTGATATCGGTACCAAATCGAATCCAAAAATTACGGATATGAATAT

>RTP10690_5'
ATTACAACGGTATATATCCTGCCAGTCAGCATCATCACACCAAAAGTTAGGCCCGAATAGTT
TGAAATTAGAAAGCTCGCAATTGAGGTCTACAGGCCAAATTCGCTCTTAGCCGTACAATATT
ACTCACCGGTGCGATGCCCCCCATCGTAGGTGAAGGTGGAAATTAATGGCGCGCCTGATC
ACTGATTAGTAACTATTACGTAAGCCTACGTAGCGTCACGTGACGTTAGCTAACGCTACGT
AGCCTCAGCTGACGTTACGTAAGCCTACGTAGCGTCACGTGAGCTTAGCTAACGCTACCTA
GGCTCAGCTGACGTTACGTAACGCTAGCTAGCGTCACTCCTGCAGCAAATTTACACA

>t-AtAHASL
GAGATGAAACCGGTGATTATCAGAACCTTTTATGGTCTTTGTATGCATATGGTAAAAAAACT
TAGTTTGCAATTTCCTGTTTGTTTTGGTAATTTGAGTTTCTTTTAGTTGTTGATCTGCCTGCT
TTTTGGTTTACGTCAGACTACTACTGCTGTTGTTGTTTGGTTTCCTTTCTTTCATTTTATAAAT

AAATAATCCGGTTCGGTTTACTCCTTGTGACTGGCTCAGTTTGGTTATTGCGAAATGCGAAT
GGTAAATTGAGTAATTGAAATTCGTTATTAGGGTTCTAAGCTGTTTTAACAGTCACTGGGTT
AATATCTCTCGAATCTTGCATGGAAAATGCTCTTACCATTGGTTTTTAATTGAAATGTGCTCA
TATGGGCCGTGGTTTCCAAATTAAATAAAACTACGATGTCATCGAGAAGTAAAATCAACTGT
GTCCACATTATCAGTTTTGTGTATACGATGAAATAGGGTAATTCAAAATCTAGCTTGATATG
CCTTTTGGTTCATTTTAACCTTCTGTAAACATTTTTTCAGATTTTGAACAAGTAAATCCAAAAA
AAAAAAAAAAAATCTCAACTCAACACTAAATTATTTTAATGTATAAAAGATGCTTAAAACATTT
GGCTTAAAAGAAAGAAGCTAAAAACATAGAGAACTCTTGTAAATTGAAGTATGAAAATATAC
TGAATTGGGTATTATATGAATTTTTCTGATTTAGGATTCACATGATCCAAAAAGGAAATCCAG
AAGCACTAATCAGACATTGGAAGTAGG
>LJB2197_5'
ACATACAAATGGACGAACGGATAAACCTTTTCACGCCCTTTTAAATATCCGATTATTCTAATA
AACGCTCTTTTCTCTTAGGTTTACCCGCCAATATATCCTGTCAAACACTGATAGTTTAAACT
GAAGGCGGGAAACGACAATCTGATCACTGATTAGTAACTAAGGCCTTTAATTAATCTAGAG
GCGCGCCGGGCCCCCTGCAGGGAGCTCGGCCGGCCAATTTAAATTGATATCGGTACATC
GATTACGCCAAGCTATCAACTTTGTATAGAAAAGTTGCCATGATTACGCCAAGCTTGGCCA
CTAAGGCCAATTTCGCGCCCTGCAGCAAATTTACACA
>LJB2197_1
CAATTTACTGATTGTGTCGACGCGATCGCGTGCAAACACTGTACGGACCGTGGCCTAATAG
GCCGGTACCCAAGTTTGTACAAAAAAGCAGGCTCCATGATTACGCCAAGCTTGGCCACTAA
GGCCAATTTAAATCTACTAGGCCGGCCATCGACGGCCCGGACTGTA
>LJB2197_2
GGCGGAGTGGGGGGCGCCTACTACCGGTAATTCCCGGGATTAGCGGCCGCTAGTCTGTG
CGCACTTGTATCCTGCAGGTTAGGCCGGCCACACGGGCAGGACATAGGG
>LJB2197_3
AAACCGAATGAAACCGATGGCGCCTACCGGTATCGGTCCGATTGCGGCCGCTTAAAGGGC
GAATTCGTTTAAACACTGTACGGACCGTGGCCTAATAGGCCGGTACCACCCAGCTTTCTTG
TACAAAGTGGCCATGATTACGCCAAGCTTGGCCACTAAGGCCAATTTAAATCTACTAGGCC
GGCCATAAGGATGACCTACCCATTCTT
>LJB2197_4
TTAATTCAGGGCCGGCCAAAGTAGGCGCCTACTACCGGTAATTCCCGGGATTAGCGGCCG
CTAGTCTGTGCGCACTTGTATCCTGCAGGTTAGGCCGGCCATTAGCAGATATTT

Table 171: Cassettes contained in the constructs VC-RTP10960-1qcz_F and VC-LJB2197-1qcz and the spacer regions in front of them, which was 5' of the promoter region. The bold lettering indicates the spacer, which corresponds to the Seq ID's listed above above.

VC-RTP10960-1qcz_F
p-VfUSP_684bp::i-Atss18_252bp::c-d6-Elo[Pp_GA2]::t-CaMV35S
RTP10690_1
p-LuCnl[1064bp]::i-Atss14_377bp::c-d5Des[Tc_GA2]::t-AgrOCS_192bp
RTP10690_2
p-SBP::i-Atss2_455bp::c-d6-Des[Ot_febit]::t-StCATHD-pA

RTP10690_3
p-LuPXR_1727bp::i-Atss1_847bp::c-d6-Elo[Tp_GA2]::t-AtPXR_400bp
RTP10690_4
p-Napin_A/B::i-Atss14_377bp::c-d12Des[Ps_GA2]::t-E9
RTP10690_5
p-LuPXR_1727bp::i-Atss15_758bp::c-w3Des[pPir_GA]::AtPXR_400bp
RTP10690_6
p-LuCnl[1064bp]::i-Atss2_455bp::c-d4Des[Pl_GA]2::t-AgrOCS_192bp
RTP10690_7
p-BnFAE1::i-Atss1_847bp::c-d5Elo[Ot_GA3]::t-bnFAE1
RTP10690_8
p-ARC5_perm1::c-d4Des[Tc_GA3]::t-pvarc
RTP10690_9
p-VfUSP_684bp::i-Atss18_252::c-w3-Des[Pi_GA2]::t-CaMV35S
RTP10690_10
p-BnSETL-v1[1234bp]::c-d5-Des[Tc_GA2]::t-BnSETL
RTP10690_11
p-BnSETL-v1[1234bp]::c-w3Des[Pir_GA]::t-BnSETL
RTP10690_12
RTP10690_5'
t-AtAHASL
VC-LJB2197-1qcz
LJB2197_5'
p-VfUSP_684bp::i-Atss18_252bp::c-d6-Elo[PpGA2]::t-CaMV35S
LJB2197_1
p-LuCnl[1064bp]::i-Atss14_377bp::c-d5Des[Tc_GA2]::t-AgrOCS_192bp
LJB2197_2
p-SBP::i-Atss2_455bp::c-d6-Des[Ot_febit]::StCATHD-pA
LJB2197_3
p-LuPXR_1727bp::i-Atss1_847bp::c-d6-Elo[Tp_GA2]::t-AtPXR_400bp
LJB2197_4
p-Napin_A/B::i-Atss14_377bp::c-d12-Des[Ps_GA]::t-E9

Transcription factors are known to bind certain sequences of DNA and from this point of interaction with the chromosome they regulate transcription of a certain gene or subset of genes. The specific sequences which are bound by the transcription factor are referred to as DNA binding motifs and can be in the range of tens of base pairs to as few as four base pairs. The majority of

DNA binding motifs consist of less than ten base pairs but those motifs have been documented to be necessary and sufficient for up (or down) regulation of transcription by the transcription factor binding to them. For examples of transcription factor motifs and the enabling data that are used to support the motifs see; Hattori et al., 2002, Keller et al., 1995, Kim et al., 2014, Lopez et al., 2013, Machens et al., 2014, Muino, 2013, Sarkar, 2013, Dubos et al., 2014). Identified motifs have been curated and archived in various data bases, such as PLACE (Higo et al., 1999), which can be accessed and queried by the public. While certain characterized promoters are used as the primary means to regulate expression of a given transgene in the invention, it was possible that alternative regulation of a transgene was occurring in the plants described in the invention due to the presence of one or more active transcription factor binding motifs in the spacer region. Examples of artificial/synthetic promoters in the public literature support this line of reasoning; see Kong et al. (2014), Nishikata et al. (2013), and Brown et al. (2014) for examples of promoters made by random assembly of nucleotides and iterative testing as well as specific fragments of known transcriptional activity assembled to make an artificial promoter. Thus the regulatory region of a given transgene in the invention also includes, in addition to the intron, terminator and the promoter used, the spacer region in front of the cassette containing the transgene.

Table 172: lists the spacer region and the transcription factor binding motif present in the region and the nucleotide sequence. Upper case letters denote the motif while surrounding bases indicate examples of sequences that might neighbor the predicted motif but are not necessary for the motif to function in the regulation of transcription

Spacer ID	Detailed Family Information	Sequence
RTP10690_1	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagg
RTP10690_1	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaacgct a
RTP10690_1	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_1	GT-box elements	gctgacGTTAcgtaacg
RTP10690_1	Cell-death specification 2	gttacGTAAcg
RTP10690_1	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_1	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_1	Cell-death specification 2	gttacGTAAcg
RTP10690_1	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_1	GT-box elements	cctagcGTTAcgtaacg
RTP10690_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacctagcgtTACGtaacgtc a
RTP10690_1	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacctagcg
RTP10690_1	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcacgtgacg
RTP10690_1	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_1	Plant G-box/C-box bZIP proteins	ctaacgtcACGTgacgctacc
RTP10690_1	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_1	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_1	ABA response elements	taacgtcaCGTGacgct
RTP10690_1	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttagc
RTP10690_1	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttag
RTP10690_1	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_1	Plant G-box/C-box bZIP proteins	gttagctaACGTcacgtgacg

RTP10690_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttagctaacgtCACGtgacgct a
RTP10690_1	Opaque-2 like transcriptional activators	tagctaACGTcacgtga
RTP10690_1	Plant G-box/C-box bZIP proteins	gtcacgTGACgttagctaacg
RTP10690_1	MYB-like proteins	cacgtgacGTTAgctaa
RTP10690_1	Plant G-box/C-box bZIP proteins	ctcagcTGACgctacctagcg
RTP10690_1	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcagctgagc
RTP10690_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgtcagctgagctTACGtaagcgc t
RTP10690_1	Vertebrate TATA binding protein factor	gcttacgTAAGctcagc
RTP10690_1	Cell-death specification 2	cttacGTAAgc
RTP10690_1	Plant G-box/C-box bZIP proteins	aagcgcttACGTaagctcagc
RTP10690_1	Opaque-2 like transcriptional activators	gcgcttACGTaagctca
RTP10690_1	Cell-death specification 2	cttacGTAAgc
RTP10690_1	Plant G-box/C-box bZIP proteins	ctgagcttACGTaagcgctta
RTP10690_1	Opaque-2 like transcriptional activators	gagcttACGTaagcgct
RTP10690_1	Vertebrate TATA binding protein factor	gcttacgTAAGcgctta
RTP10690_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	tatctgctaagcgctTACGtaagctca
RTP10690_1	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium	tctgctaagcgcttACGTaag
RTP10690_1	Arabidopsis CDC5 homolog	tgctaAGCGct
RTP10690_2	Cell-death specification 2	cttagGTAAgc
RTP10690_2	Opaque-2 like transcriptional activators	gagcctACGTagcctta
RTP10690_2	ABA response elements	taggctcaCGTGacgtt
RTP10690_2	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgagcctacg
RTP10690_2	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgagcctac
RTP10690_2	Opaque-2 like transcriptional activators	aacgtcACGTgagccta
RTP10690_2	Plant G-box/C-box bZIP proteins	gtaggctcACGTgacgttacg
RTP10690_2	Myc-like basic helix-loop-helix binding factors	taggctCACGtgacgttac
RTP10690_2	Opaque-2 like transcriptional activators	aggctcACGTgacgtta
RTP10690_2	Cell-death specification 2	gtaacGTCAcg
RTP10690_2	Plant G-box/C-box bZIP proteins	cttacgtaACGTcacgtgagc
RTP10690_2	Opaque-2 like transcriptional activators	tacgtaACGTcacgtga
RTP10690_2	Plant G-box/C-box bZIP proteins	ctcacgTGACgttacgtaagg
RTP10690_2	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggctcacgtgacgtTACGtaaggct a
RTP10690_2	Opaque-2 like transcriptional activators	cacgtgACGTtacgtaa
RTP10690_2	GT-box elements	cgtgacGTTAcgtaagg
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_2	Cell-death specification 2	cttacGTAAcg
RTP10690_2	Plant G-box/C-box bZIP proteins	gtagccttACGTaacgtcacg
RTP10690_2	Opaque-2 like transcriptional activators	agccttACGTaacgtca
RTP10690_2	Cell-death specification 2	gttacGTAAgg
RTP10690_2	Opaque-2 like transcriptional activators	gacgttACGTaaggcta
RTP10690_2	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacgtagcctTACGtaacgtc a
RTP10690_2	Opaque-2 like transcriptional activators	gacgctACGTagcctta
RTP10690_2	Plant G-box/C-box bZIP proteins	gtaaggctACGTagcgtcacg
RTP10690_2	Opaque-2 like transcriptional activators	aaggctACGTagcgtca
RTP10690_2	Plant G-box/C-box bZIP proteins	ctcacgTGACgctacgtagcc
RTP10690_2	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcacgtgagc

RTP10690_2	Plant G-box/C-box bZIP proteins	gtaagctcACGTgacgctacg
RTP10690_2	Myc-like basic helix-loop-helix binding factors	taagctCACGtgacgctac
RTP10690_2	Opaque-2 like transcriptional activators	aagctcACGTgacgcta
RTP10690_2	ABA response elements	taagctcaCGTGacgct
RTP10690_2	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgagcttacc
RTP10690_2	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgagcttac
RTP10690_2	Opaque-2 like transcriptional activators	agcgtcACGTgagctta
RTP10690_2	GT-box elements	cgtcacGTGAgcttacc
RTP10690_2	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agagttaggtaagctCACGtgacgct a
RTP10690_2	Cell-death specification 2	gttagGTAAgc
RTP10690_2	MYB IIG-type binding sites	tagagttaGGTAagc
RTP10690_2	MYB-like proteins	tagctagAGTTaggtaa
RTP10690_2	ABA response elements	tagcctcaCGTGacctt
RTP10690_2	Plant G-box/C-box bZIP proteins	ctaaggtcACGTgaggctagc
RTP10690_2	Myc-like basic helix-loop-helix binding factors	taaggtCACGtgaggctag
RTP10690_2	Opaque-2 like transcriptional activators	aaggtcACGTgaggcta
RTP10690_2	Dc3 promoter binding factors	cTCACgtgacc
RTP10690_2	Plant G-box/C-box bZIP proteins	ctagcctcACGTgaccttagc
RTP10690_2	Myc-like basic helix-loop-helix binding factors	tagcctCACGtgaccttag
RTP10690_2	Opaque-2 like transcriptional activators	agcctcACGTgacctta
RTP10690_2	GT-box elements	cctcacGTGAccttagc
RTP10690_2	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agtgttagctaaggtCACGtgaggct a
RTP10690_2	Plant G-box/C-box bZIP proteins	tcgagcTGACgctacctagtg
RTP10690_2	Plant G-box/C-box bZIP proteins	actaggtaGCGTcagctcgac
RTP10690_3	Opaque-2 like transcriptional activators	gacgctACGTagcccca
RTP10690_3	Plant G-box/C-box bZIP proteins	gtggggctACGTagcgtcacg
RTP10690_3	Opaque-2 like transcriptional activators	ggggctACGTagcgtca
RTP10690_3	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacgtagcc
RTP10690_3	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcacgtgacg
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_3	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_3	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgacgctacg
RTP10690_3	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_3	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_3	ABA response elements	taacgtcaCGTGacgct
RTP10690_3	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttacc
RTP10690_3	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttac
RTP10690_3	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_3	Cell-death specification 2	gtaacGTCAcg
RTP10690_3	Plant G-box/C-box bZIP proteins	cttaggtaACGTcacgtgacg
RTP10690_3	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggcttaggtaacgtCACGtgacgct a
RTP10690_3	Opaque-2 like transcriptional activators	taggtaACGTcacgtga
RTP10690_3	Plant G-box/C-box bZIP proteins	gtcacgTGACgttacctaagc
RTP10690_3	Opaque-2 like transcriptional activators	cacgtgACGTtacctaa
RTP10690_3	GT-box elements	cgtgacGTTAcctaagc
RTP10690_3	Cell-death specification 2	cttagGTAAcg
RTP10690_3	Vertebrate TATA binding protein factor	cgttaccTAAGcctagg
RTP10690_3	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagg

RTP10690_3	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_3	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaacgct a
RTP10690_3	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_3	GT-box elements	gctgacGTTAcgtaacg
RTP10690_3	Cell-death specification 2	gttacGTAAcg
RTP10690_3	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_3	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_3	Cell-death specification 2	gttacGTAAcg
RTP10690_3	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_3	GT-box elements	cctagcGTTAcgtaacg
RTP10690_3	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gagcctacctagcgtTACGtaacgtc a
RTP10690_3	Calmodulin binding / CGCG box binding proteins	gccCGTGtcagctgagc
RTP10690_3	Bel-1 similar region	tgtcctgcccgtgTCAGctgagc
RTP10690_4	Dehydration responsive element binding factors	gaatgaaaCCGAtctacgtag
RTP10690_4	Light responsive element motif, not modulated by different light qualities	cgATCTacgta
RTP10690_4	Plant G-box/C-box bZIP proteins	ataatctcACGTgaggctagg
RTP10690_4	Myc-like basic helix-loop-helix binding factors	taatctCACGtgaggctag
RTP10690_4	Opaque-2 like transcriptional activators	aatctcACGTgaggcta
RTP10690_4	ABA response elements	taatctcACGTgaggct
RTP10690_4	Plant G-box/C-box bZIP proteins	ctagcctcACGTgagattatg
RTP10690_4	Myc-like basic helix-loop-helix binding factors	tagcctCACGtgagattat
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_4	Opaque-2 like transcriptional activators	agcctcACGTgagatta
RTP10690_4	Brassinosteroid (BR) response element	cctcaCGTGagattatg
RTP10690_4	Cell-death specification 2	attatGTAAgg
RTP10690_4	Vertebrate TATA binding protein factor	gattatgTAAGgctagg
RTP10690_4	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacctagcc
RTP10690_4	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcacgtgacg
RTP10690_4	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_4	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgacgctacc
RTP10690_4	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_4	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_4	ABA response elements	taacgtcaCGTGacgct
RTP10690_4	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttacc
RTP10690_4	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttac
RTP10690_4	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_4	Cell-death specification 2	gtaacGTCAcg
RTP10690_4	Plant G-box/C-box bZIP proteins	gttaggtaACGTcacgtgacg
RTP10690_4	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agtgttaggtaacgtCACGtgacgct a
RTP10690_4	Opaque-2 like transcriptional activators	taggtaACGTcacgtga
RTP10690_4	Plant G-box/C-box bZIP proteins	gtcacgTGACgttacctaaca
RTP10690_4	Opaque-2 like transcriptional activators	cacgtgACGTtacctaa
RTP10690_4	GT-box elements	cgtgacGTTAcctaaca
RTP10690_4	Cell-death specification 2	gttagGTAAcg
RTP10690_4	Plant G-box/C-box bZIP proteins	ctcagcTGACgctagctagtg
RTP10690_4	Plant G-box/C-box bZIP proteins	actagctaGCGTcagctgagc
RTP10690_4	Telo box (plant interstitial telomere motifs)	gctaaCCCTacgtag

RTP10690_4	Opaque-2 like transcriptional activators	aaccctACGTagcctca
RTP10690_4	Brassinosteroid (BR) response element	gctcaCGTGaggctacg
RTP10690_4	Plant G-box/C-box bZIP proteins	gtaagctcACGTgaggctacg
RTP10690_4	Myc-like basic helix-loop-helix binding factors	taagctCACGtgaggctac
RTP10690_4	Opaque-2 like transcriptional activators	aagctcACGTgaggcta
RTP10690_4	Plant G-box/C-box bZIP proteins	gtagcctcACGTgagcttacc
RTP10690_4	Myc-like basic helix-loop-helix binding factors	tagcctCACGtgagcttac
RTP10690_4	Opaque-2 like transcriptional activators	agcctcACGTgagctta
RTP10690_4	Brassinosteroid (BR) response element	cctcaCGTGagcttacc
RTP10690_4	GT-box elements	cctcacGTGAgcttacc
RTP10690_4	Cell-death specification 2	gttagGTAAgc
RTP10690_4	MYB IIG-type binding sites	tagcgttaGGTAagc
RTP10690_4	Core promoter motif ten elements	cttacctAACGctacgtagcc
RTP10690_4	Plant G-box/C-box bZIP proteins	gtgaggctACGTagcgttagg
RTP10690_4	Opaque-2 like transcriptional activators	gaggctACGTagcgtta
RTP10690_4	Opaque-2 like transcriptional activators	aacgctACGTagcctca
RTP10690_4	Root hair-specific cis-elements in angiosperms	aacgctacgtagcctCACGtgacta
RTP10690_4	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aacgctacgtagcctCACGtgactaag
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_4	ABA response elements	tagcctcaCGTGactaa
RTP10690_4	Plant G-box/C-box bZIP proteins	ccttagtcACGTgaggctacg
RTP10690_4	Myc-like basic helix-loop-helix binding factors	cttagtCACGtgaggctac
RTP10690_4	Opaque-2 like transcriptional activators	ttagtcACGTgaggcta
RTP10690_4	Plant G-box/C-box bZIP proteins	gtagcctcACGTgactaagga
RTP10690_4	Myc-like basic helix-loop-helix binding factors	tagcctCACGtgactaagg
RTP10690_4	Opaque-2 like transcriptional activators	agcctcACGTgactaag
RTP10690_4	GT-box elements	cctcacGTGActaagga
RTP10690_4	MYB IIG-type binding sites	aatgGGTAggtcatc
RTP10690_5	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagg
RTP10690_5	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaacgcta
RTP10690_5	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_5	GT-box elements	gctgacGTTAcgtaacg
RTP10690_5	Cell-death specification 2	gttacGTAAcg
RTP10690_5	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_5	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_5	Cell-death specification 2	gttacGTAAcg
RTP10690_5	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_5	GT-box elements	cctagcGTTAcgtaacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacctagcgtTACGtaacgtca
RTP10690_5	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacctagcg
RTP10690_5	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcacgtgacg
RTP10690_5	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_5	Plant G-box/C-box bZIP proteins	ctaacgtcACGTgacgctacc
RTP10690_5	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_5	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_5	ABA response elements	taacgtcaCGTGacgct
RTP10690_5	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttagc

RTP10690_5	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttag
RTP10690_5	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_5	Plant G-box/C-box bZIP proteins	gttagctaACGTcacgtgacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttagctaacgtCACGtgacgct a
RTP10690_5	Opaque-2 like transcriptional activators	tagctaACGTcacgtga
RTP10690_5	Plant G-box/C-box bZIP proteins	gtcacgTGACgttagctaacg
RTP10690_5	MYB-like proteins	cacgtgacGTTAgctaa
RTP10690_5	Plant G-box/C-box bZIP proteins	ctcagcTGACgctacctagcg
RTP10690_5	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcagctgagc
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgtcagctgagctTACGtaagcgc c
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_5	Vertebrate TATA binding protein factor	gcttacgTAAGctcagc
RTP10690_5	Cell-death specification 2	cttacGTAAgc
RTP10690_5	Plant G-box/C-box bZIP proteins	tggcgcttACGTaagctcagc
RTP10690_5	Opaque-2 like transcriptional activators	gcgcttACGTaagctca
RTP10690_5	Cell-death specification 2	cttacGTAAgc
RTP10690_5	Plant G-box/C-box bZIP proteins	ctgagcttACGTaagcgccac
RTP10690_5	Opaque-2 like transcriptional activators	gagcttACGTaagcgcc
RTP10690_5	Vertebrate TATA binding protein factor	gcttacgTAAGcgccac
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	cctgcccgtggcgctTACGtaagctca
RTP10690_5	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	tgcccgtggcgctTACGtaag
RTP10690_5	Calmodulin binding / CGCG box binding proteins	gccCGTGgcgcttacgt
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcttacgtaagcgccACGGcagg ac
RTP10690_5	Plant G-box/C-box bZIP proteins	tgtcctgcCCGTggcgcttac
RTP10690_6	Dehydration responsive element binding factors	gaatgaaaCCGAtctacgtag
RTP10690_6	Light responsive element motif, not modulated by different light qualities	cgATCTacgta
RTP10690_6	Cell-death specification 2	cttagGTAAgc
RTP10690_6	Opaque-2 like transcriptional activators	gagcctACGTagcctta
RTP10690_6	ABA response elements	taggctcaCGTGacgtt
RTP10690_6	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgagcctacg
RTP10690_6	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgagcctac
RTP10690_6	Opaque-2 like transcriptional activators	aacgtcACGTgagccta
RTP10690_6	Plant G-box/C-box bZIP proteins	gtaggctcACGTgacgttacg
RTP10690_6	Myc-like basic helix-loop-helix binding factors	taggctCACGtgacgttac
RTP10690_6	Opaque-2 like transcriptional activators	aggctcACGTgacgtta
RTP10690_6	Cell-death specification 2	gtaacGTCAcg
RTP10690_6	Plant G-box/C-box bZIP proteins	cttacgtaACGTcacgtgagc
RTP10690_6	Opaque-2 like transcriptional activators	tacgtaACGTcacgtga
RTP10690_6	Plant G-box/C-box bZIP proteins	ctcacgTGACgttacgtaagg
RTP10690_6	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggctcacgtgacgtTACGtaaggct a
RTP10690_6	Opaque-2 like transcriptional activators	cacgtgACGTtacgtaa
RTP10690_6	GT-box elements	cgtgacGTTAcgtaagg
RTP10690_6	Cell-death specification 2	cttacGTAAcg

RTP10690_6	Plant G-box/C-box bZIP proteins	gtagccttACGTaacgtcacg
RTP10690_6	Opaque-2 like transcriptional activators	agccttACGTaacgtca
RTP10690_6	Cell-death specification 2	gttacGTAAgg
RTP10690_6	Opaque-2 like transcriptional activators	gacgttACGTaaggcta
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_6	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacgtagcctTACGtaacgtca
RTP10690_6	Opaque-2 like transcriptional activators	gacgctACGTagcctta
RTP10690_6	Plant G-box/C-box bZIP proteins	gtaaggctACGTagcgtcacg
RTP10690_6	Opaque-2 like transcriptional activators	aaggctACGTagcgtca
RTP10690_6	Plant G-box/C-box bZIP proteins	ctcacgTGACgctacgtagcc
RTP10690_6	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcacgtgagc
RTP10690_6	Plant G-box/C-box bZIP proteins	gtaagctcACGTgacgctacg
RTP10690_6	Myc-like basic helix-loop-helix binding factors	taagctCACGtgacgctac
RTP10690_6	Opaque-2 like transcriptional activators	aagctcACGTgacgcta
RTP10690_6	ABA response elements	taagctcaCGTGacgct
RTP10690_6	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgagcttacc
RTP10690_6	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgagcttac
RTP10690_6	Opaque-2 like transcriptional activators	agcgtcACGTgagctta
RTP10690_6	GT-box elements	cgtcacGTGAgcttacc
RTP10690_6	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agagttaggtaagctCACGtgacgcta
RTP10690_6	Cell-death specification 2	gttagGTAAgc
RTP10690_6	MYB IIG-type binding sites	tagagttaGGTAagc
RTP10690_6	MYB-like proteins	tagctagAGTTaggtaa
RTP10690_6	ABA response elements	tagcctcaCGTGacctt
RTP10690_6	Plant G-box/C-box bZIP proteins	ctaaggtcACGTgaggctagc
RTP10690_6	Myc-like basic helix-loop-helix binding factors	taaggtCACGtgaggctag
RTP10690_6	Opaque-2 like transcriptional activators	aaggtcACGTgaggcta
RTP10690_6	Dc3 promoter binding factors	cTCACgtgacc
RTP10690_6	Plant G-box/C-box bZIP proteins	ctagcctcACGTgaccttagc
RTP10690_6	Myc-like basic helix-loop-helix binding factors	tagcctCACGtgaccttag
RTP10690_6	Opaque-2 like transcriptional activators	agcctcACGTgacctta
RTP10690_6	GT-box elements	cctcacGTGAccttagc
RTP10690_6	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agtgttagctaaggtCACGtgaggcta
RTP10690_6	Plant G-box/C-box bZIP proteins	ctaagcTGACgctacctagtg
RTP10690_7	L1 box, motif for L1 layer-specific expression	aatCAGTaaattgaacg
RTP10690_7	Arabidopsis homeobox protein	caaTTTActga
RTP10690_7	Sucrose box	gaCAATcagtaaattgaac
RTP10690_7	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	tttactgattgtctACGTagc
RTP10690_7	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aatttactgattgtcTACGtagcgtca
RTP10690_7	Plant G-box/C-box bZIP proteins	gattgtctACGTagcgtcacc
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_7	Plant G-box/C-box bZIP proteins	gtcaggTGACgctacgtagac

RTP10690_7	Plant G-box/C-box bZIP proteins	tctacgtaGCGTcacctgacg
RTP10690_7	Plant G-box/C-box bZIP proteins	cgtagcgtcaccTGACgttac
RTP10690_7	Plant G-box/C-box bZIP proteins	cttacgtaACGTcaggtgacg
RTP10690_7	Plant G-box/C-box bZIP proteins	gtcaccTGACgttacgtaagg
RTP10690_7	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgtcacctgacgtTACGtaaggct a
RTP10690_7	Opaque-2 like transcriptional activators	cacctgACGTtacgtaa
RTP10690_7	GT-box elements	cctgacGTTAcgtaagg
RTP10690_7	Cell-death specification 2	cttacGTAAcg
RTP10690_7	Plant G-box/C-box bZIP proteins	gtagccttACGTaacgtcagg
RTP10690_7	Opaque-2 like transcriptional activators	agccttACGTaacgtca
RTP10690_7	Cell-death specification 2	gttacGTAAgg
RTP10690_7	Opaque-2 like transcriptional activators	gacgttACGTaaggcta
RTP10690_7	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gagcctaggtagcctTACGtaacgtc a
RTP10690_7	ABA response elements	taggctcaCGTGacgtt
RTP10690_7	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgagcctagg
RTP10690_7	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgagcctag
RTP10690_7	Opaque-2 like transcriptional activators	aacgtcACGTgagccta
RTP10690_7	Plant G-box/C-box bZIP proteins	ctaggctcACGTgacgttacg
RTP10690_7	Myc-like basic helix-loop-helix binding factors	taggctCACGtgacgttac
RTP10690_7	Opaque-2 like transcriptional activators	aggctcACGTgacgtta
RTP10690_7	Cell-death specification 2	gtaacGTCAcg
RTP10690_7	Plant G-box/C-box bZIP proteins	gttacgtaACGTcacgtgagc
RTP10690_7	Opaque-2 like transcriptional activators	tacgtaACGTcacgtga
RTP10690_7	Plant G-box/C-box bZIP proteins	ctcacgTGACgttacgtaacg
RTP10690_7	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggctcacgtgacgtTACGtaacgct a
RTP10690_7	Opaque-2 like transcriptional activators	cacgtgACGTtacgtaa
RTP10690_7	GT-box elements	cgtgacGTTAcgtaacg
RTP10690_7	Cell-death specification 2	gttacGTAAcg
RTP10690_7	Plant G-box/C-box bZIP proteins	gtagcgttACGTaacgtcacg
RTP10690_7	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_7	Cell-death specification 2	gttacGTAAcg
RTP10690_7	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_7	GT-box elements	cgtagcGTTAcgtaacg
RTP10690_7	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacgtagcgtTACGtaacgtc a
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_7	Plant G-box/C-box bZIP proteins	ctgacgctACGTagcgttacg
RTP10690_7	Opaque-2 like transcriptional activators	gacgctACGTagcgtta
RTP10690_7	Plant G-box/C-box bZIP proteins	gtaacgctACGTagcgtcagg
RTP10690_7	Opaque-2 like transcriptional activators	aacgctACGTagcgtca
RTP10690_7	Plant G-box/C-box bZIP proteins	ctcaccTGACgctacgtagcg
RTP10690_7	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcaggtgagg
RTP10690_7	MYB-like proteins	caggtgagGTTAgctaa
RTP10690_7	Plant G-box/C-box bZIP proteins	cttacctaACGTcaggtgagg
RTP10690_7	Plant G-box/C-box bZIP proteins	ctcaccTGACgttaggtaagg

RTP10690_7	MYB IIG-type binding sites	tgacgttaGGTAagg
RTP10690_7	Cell-death specification 2	gttagGTAAgg
RTP10690_7	GT-box elements	cgttagGTAAggctacg
RTP10690_7	Opaque-2 like transcriptional activators	gacgctACGTagcctta
RTP10690_7	Plant G-box/C-box bZIP proteins	gtaaggctACGTagcgtcacc
RTP10690_7	Opaque-2 like transcriptional activators	aaggctACGTagcgtca
RTP10690_7	Plant G-box/C-box bZIP proteins	ctcaggTGACgctacgtagcc
RTP10690_7	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcacctgaga
RTP10690_7	Myc-like basic helix-loop-helix binding factors	tagcgtCACCtgagattag
RTP10690_7	ABA response elements	tagactcaCGTGacctt
RTP10690_7	Plant G-box/C-box bZIP proteins	ctaaggtcACGTgagtctagg
RTP10690_7	Myc-like basic helix-loop-helix binding factors	taaggtCACGtgagtctag
RTP10690_7	Opaque-2 like transcriptional activators	aaggtcACGTgagtcta
RTP10690_7	TEF-box	ctAAGGtcacgtgagtctagg
RTP10690_7	Dc3 promoter binding factors	cTCACgtgacc
RTP10690_7	Plant G-box/C-box bZIP proteins	ctagactcACGTgaccttagg
RTP10690_7	Myc-like basic helix-loop-helix binding factors	tagactCACGtgaccttag
RTP10690_7	Opaque-2 like transcriptional activators	agactcACGTgacctta
RTP10690_7	GT-box elements	actcacGTGAccttagg
RTP10690_7	Cell-death specification 2	cttagGTAAcg
RTP10690_7	GT-box elements	ccttagGTAAcgctacg
RTP10690_7	GT-box elements	cgtagcGTTAcctaagg
RTP10690_7	Plant G-box/C-box bZIP proteins	ttgacgctACGTagcgttacc
RTP10690_7	Opaque-2 like transcriptional activators	gacgctACGTagcgtta
RTP10690_7	Plant G-box/C-box bZIP proteins	gtaacgctACGTagcgtcaaa
RTP10690_7	Opaque-2 like transcriptional activators	aacgctACGTagcgtca
RTP10690_7	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gtaaagctttgacgctACGTagcgtta
RTP10690_7	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcaaagcttt
RTP10690_7	Calcium regulated NAC-factors	taaaGCTTtgacgctacgtag
RTP10690_7	W Box family	aagctTTGAcgctacgt
RTP10690_7	Tracheary-element-regulating cis-elements, conferring TE-specific expression	cgtcAAAGctt
RTP10690_7	Vertebrate TATA binding protein factor	cgttgTAAAgctttgac
RTP10690_7	DNA binding with one finger (DOF)	agcgttgtAAAGctttg
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_7	Mitochondral HMG-box transcription factor	tgtagcgTTGTaa
RTP10690_8	Secondary wall NACS	gattttagttcTAAGttag
RTP10690_8	AS1/AS2 repressor complex	gagTTGAtt
RTP10690_8	Calmodulin binding / CGCG box binding proteins	agaCGCGtcacaaagag
RTP10690_8	Coupling element 3 sequence	ggtagaCGCGtcacaaaga
RTP10690_8	Plant G-box/C-box bZIP proteins	aggtagacGCGTcacaaagag
RTP10690_8	Plant G-box/C-box bZIP proteins	tctttgTGACgcgtctaccta
RTP10690_8	Calmodulin binding / CGCG box binding proteins	tgaCGCGtctacctaga
RTP10690_8	Plant G-box/C-box bZIP proteins	gctagtgtcagcTGACgttac
RTP10690_8	Plant G-box/C-box bZIP proteins	cttacgtaACGTcagctgaca
RTP10690_8	Plant G-box/C-box bZIP proteins	gtcagcTGACgttacgtaagg
RTP10690_8	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agtgtcagctgacgtTACGtaaggct a
RTP10690_8	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_8	GT-box elements	gctgacGTTAcgtaagg

RTP10690_8	Cell-death specification 2	cttacGTAAcg
RTP10690_8	Plant G-box/C-box bZIP proteins	ttagccttACGTaacgtcagc
RTP10690_8	Opaque-2 like transcriptional activators	agccttACGTaacgtca
RTP10690_8	Cell-death specification 2	gttacGTAAgg
RTP10690_8	Opaque-2 like transcriptional activators	gacgttACGTaaggcta
RTP10690_8	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctagttagcctTACGtaacgtca
RTP10690_8	MYB-like proteins	tgacgctAGTTagcctt
RTP10690_8	Plant G-box/C-box bZIP proteins	gtcacgTGACgctagttagcc
RTP10690_8	ABA response elements	tagcgtcaCGTGacctt
RTP10690_8	Plant G-box/C-box bZIP proteins	gtaaggtcACGTgacgctagt
RTP10690_8	Myc-like basic helix-loop-helix binding factors	taaggtCACGtgacgctag
RTP10690_8	Opaque-2 like transcriptional activators	aaggtcACGTgacgcta
RTP10690_8	ABA response elements	taaggtcaCGTGacgct
RTP10690_8	Dc3 promoter binding factors	gTCACgtgacc
RTP10690_8	Plant G-box/C-box bZIP proteins	ctagcgtcACGTgaccttacg
RTP10690_8	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgaccttac
RTP10690_8	Opaque-2 like transcriptional activators	agcgtcACGTgacctta
RTP10690_8	GT-box elements	cgtcacGTGAccttacg
RTP10690_8	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttacgtaaggtCACGtgacgct a
RTP10690_8	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgtcacgtgacctTACGtaacgct a
RTP10690_8	Cell-death specification 2	gttacGTAAgg
RTP10690_8	Plant G-box/C-box bZIP proteins	gtagcgttACGTaaggtcacg
RTP10690_8	Opaque-2 like transcriptional activators	agcgttACGTaaggtca
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_8	Cell-death specification 2	cttacGTAAcg
RTP10690_8	Opaque-2 like transcriptional activators	gaccttACGTaacgcta
RTP10690_8	GT-box elements	cgtagcGTTAcgtaagg
RTP10690_8	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gagcctacgtagcgtTACGtaaggtc a
RTP10690_8	Plant G-box/C-box bZIP proteins	ctgagcctACGTagcgttacg
RTP10690_8	Opaque-2 like transcriptional activators	gagcctACGTagcgtta
RTP10690_8	Telo box (plant interstitial telomere motifs)	gctaACCCtagctag
RTP10690_8	ABA response elements	tagtgtcACGTgagctt
RTP10690_8	Plant G-box/C-box bZIP proteins	gtaagctcACGTgacactagc
RTP10690_8	Myc-like basic helix-loop-helix binding factors	taagctCACGtgacactag
RTP10690_8	Opaque-2 like transcriptional activators	aagctcACGTgacacta
RTP10690_8	ABA response elements	taagctcaCGTGacact
RTP10690_8	Plant G-box/C-box bZIP proteins	ctagtgtcACGTgagcttacg
RTP10690_8	Myc-like basic helix-loop-helix binding factors	tagtgtCACGtgagcttac
RTP10690_8	Opaque-2 like transcriptional activators	agtgtcACGTgagctta
RTP10690_8	GT-box elements	tgtcacGTGAgcttacg
RTP10690_8	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	tgtcacgtgagctTACGctac
RTP10690_8	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agtgtcacgtgagctTACGctactata
RTP10690_8	Cell-death specification 2	gtagcGTAAgc

RTP10690_8	Pollen-specific regulatory elements	ctataGAAAatgtgtta
RTP10690_9	CA-rich motif	agtctaaAACAactacgta
RTP10690_9	General transcription factor IID, GTF2D	tcagtctaaaacaactacgtagcgtcacgtGACGttacc
RTP10690_9	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacgtagtt
RTP10690_9	Plant G-box/C-box bZIP proteins	actacgtaGCGTcacgtgacg
RTP10690_9	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_9	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgacgctacg
RTP10690_9	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_9	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_9	ABA response elements	taacgtcaCGTGacgct
RTP10690_9	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttacc
RTP10690_9	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttac
RTP10690_9	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_9	Cell-death specification 2	gtaacGTCAcg
RTP10690_9	Plant G-box/C-box bZIP proteins	cttaggtaACGTcacgtgacg
RTP10690_9	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggcttaggtaacgtCACGtgacgcta
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_9	Opaque-2 like transcriptional activators	taggtaACGTcacgtga
RTP10690_9	Plant G-box/C-box bZIP proteins	gtcacgTGACgttacctaagc
RTP10690_9	Opaque-2 like transcriptional activators	cacgtgACGTtacctaa
RTP10690_9	GT-box elements	cgtgacGTTAcctaagc
RTP10690_9	Cell-death specification 2	cttagGTAAcg
RTP10690_9	Vertebrate TATA binding protein factor	cgttaccTAAGcctagg
RTP10690_9	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagg
RTP10690_9	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_9	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaacgcta
RTP10690_9	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_9	GT-box elements	gctgacGTTAcgtaacg
RTP10690_9	Cell-death specification 2	gttacGTAAcg
RTP10690_9	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_9	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_9	Cell-death specification 2	gttacGTAAcg
RTP10690_9	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_9	GT-box elements	cctagcGTTAcgtaacg
RTP10690_9	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gagcctacctagcgtTACGtaacgtca
RTP10690_9	Upstream sequence element of U-snRNA genes	aaatttACACattgcca
RTP10690_10	Opaque-2 like transcriptional activators	gagcctACGTagctgaa
RTP10690_10	Cell-death specification 2	cttagGTAAgc
RTP10690_10	Opaque-2 like transcriptional activators	gagcctACGTagcctta
RTP10690_10	ABA response elements	taggctcaCGTGacgtt
RTP10690_10	Plant G-box/C-box bZIP proteins	gtaacgtcACGTgagcctacg

RTP10690_10	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgagcctac
RTP10690_10	Opaque-2 like transcriptional activators	aacgtcACGTgagccta
RTP10690_10	Plant G-box/C-box bZIP proteins	gtaggctcACGTgacgttacg
RTP10690_10	Myc-like basic helix-loop-helix binding factors	taggctCACGtgacgttac
RTP10690_10	Opaque-2 like transcriptional activators	aggctcACGTgacgtta
RTP10690_10	Cell-death specification 2	gtaacGTCAcg
RTP10690_10	Plant G-box/C-box bZIP proteins	cttacgtaACGTcacgtgagc
RTP10690_10	Opaque-2 like transcriptional activators	tacgtaACGTcacgtga
RTP10690_10	Plant G-box/C-box bZIP proteins	ctcacgTGACgttacgtaagg
RTP10690_10	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggctcacgtgacgtTACGtaaggcta
RTP10690_10	Opaque-2 like transcriptional activators	cacgtgACGTtacgtaa
RTP10690_10	GT-box elements	cgtgacGTTAcgtaagg
RTP10690_10	Cell-death specification 2	cttacGTAAcg
RTP10690_10	Plant G-box/C-box bZIP proteins	gtagccttACGTaacgtcacg
RTP10690_10	Opaque-2 like transcriptional activators	agccttACGTaacgtca
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_10	Cell-death specification 2	gttacGTAAgg
RTP10690_10	Opaque-2 like transcriptional activators	gacgttACGTaaggcta
RTP10690_10	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacgtagcctTACGtaacgtca
RTP10690_10	Opaque-2 like transcriptional activators	gacgctACGTagcctta
RTP10690_10	Plant G-box/C-box bZIP proteins	gtaaggctACGTagcgtcacg
RTP10690_10	Opaque-2 like transcriptional activators	aaggctACGTagcgtca
RTP10690_10	Plant G-box/C-box bZIP proteins	ctcacgTGACgctacgtagcc
RTP10690_10	Plant G-box/C-box bZIP proteins	gctacgtaGCGTcacgtgagc
RTP10690_10	Plant G-box/C-box bZIP proteins	gtaagctcACGTgacgctacg
RTP10690_10	Myc-like basic helix-loop-helix binding factors	taagctCACGtgacgctac
RTP10690_10	Opaque-2 like transcriptional activators	aagctcACGTgacgcta
RTP10690_10	ABA response elements	taagctcaCGTGacgct
RTP10690_10	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgagcttacc
RTP10690_10	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgagcttac

RTP10690_10	Opaque-2 like transcriptional activators	agcgtcACGTgagctta
RTP10690_10	GT-box elements	cgtcacGTGAgcttacc
RTP10690_10	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agagttaggtaagctCACGtgacgcta
RTP10690_10	Cell-death specification 2	gttagGTAAgc
RTP10690_10	MYB IIG-type binding sites	tagagttaGGTAagc
RTP10690_10	MYB-like proteins	tagctagAGTTaggtaa
RTP10690_10	ABA response elements	tagcctcaCGTGacctt
RTP10690_10	Plant G-box/C-box bZIP proteins	ctaaggtcACGTgaggctagc
RTP10690_10	Myc-like basic helix-loop-helix binding factors	taaggtCACGtgaggctag
RTP10690_10	Opaque-2 like transcriptional activators	aaggtcACGTgaggcta
RTP10690_10	Dc3 promoter binding factors	cTCACgtgacc
RTP10690_10	Plant G-box/C-box bZIP proteins	ctagcctcACGTgaccttagc
RTP10690_10	Myc-like basic helix-loop-helix binding factors	tagcctCACGtgaccttag
RTP10690_10	Opaque-2 like transcriptional activators	agcctcACGTgacctta
RTP10690_10	GT-box elements	cctcacGTGAccttagc
RTP10690_10	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agtgttagctaaggtCACGtgaggcta
RTP10690_10	Plant G-box/C-box bZIP proteins	ctgtgcTGACgctacctagtg
RTP10690_10	Plant G-box/C-box bZIP proteins	actaggtaGCGTcagcacaga
RTP10690_10	Myc-like basic helix-loop-helix binding factors	agtattCATCtgtgctgac
RTP10690_10	GAP-Box (light response elements)	acagATGAatactag
RTP10690_11	VIP1 responsive elements	acacgGCTCag
RTP10690_11	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagg
RTP10690_11	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_11	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaacgcta
RTP10690_11	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_11	GT-box elements	gctgacGTTAcgtaacg
RTP10690_11	Cell-death specification 2	gttacGTAAcg
RTP10690_11	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_11	Opaque-2 like transcriptional activators	agcgttACGTaacgtca

RTP10690_1 1	Cell-death specification 2	gttacGTAAcg
RTP10690_1 1	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_1 1	GT-box elements	cctagcGTTAcgtaacg
RTP10690_1 1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacctagcgtTACGtaacgtc a
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacctagcg
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcacgtgacg
RTP10690_1 1	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_1 1	Plant G-box/C-box bZIP proteins	ctaacgtcACGTgacgctacc
RTP10690_1 1	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_1 1	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_1 1	ABA response elements	taacgtcaCGTGacgct
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttagc
RTP10690_1 1	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttag
RTP10690_1 1	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gttagctaACGTcacgtgacg
RTP10690_1 1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttagctaacgtCACGtgacgct a
RTP10690_1 1	Opaque-2 like transcriptional activators	tagctaACGTcacgtga
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gtcacgTGACgttagctaacg
RTP10690_1 1	MYB-like proteins	cacgtgacGTTAgctaa
RTP10690_1 1	Plant G-box/C-box bZIP proteins	ctcagcTGACgctacctagcg
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcagctgagc
RTP10690_1 1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgtcagctgagctTACGtaagcgc a
RTP10690_1 1	Vertebrate TATA binding protein factor	gcttacgTAAGctcagc
RTP10690_1 1	Cell-death specification 2	cttacGTAAgc
RTP10690_1 1	Plant G-box/C-box bZIP proteins	gtgcgcttACGTaagctcagc
RTP10690_1 1	Opaque-2 like transcriptional activators	gcgcttACGTaagctca
RTP10690_1 1	Cell-death specification 2	cttacGTAAgc
RTP10690_1 1	Plant G-box/C-box bZIP proteins	ctgagcttACGTaagcgcaca
RTP10690_1 1	Opaque-2 like transcriptional activators	gagcttACGTaagcgca
RTP10690_1 1	Vertebrate TATA binding protein factor	gcttacgTAAGcgcaca

RTP10690_11	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	attcatctgtgcgctTACGtaagctca
RTP10690_11	Plant G-box/C-box bZIP proteins	tcatctgtgcgcTTACgtaag
RTP10690_11	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	tcatctgtgcgctTACGtaag
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_11	Myc-like basic helix-loop-helix binding factors	agtattCATCtgtgcgctt
RTP10690_11	GAP-Box (light response elements)	acagATGAatactag
RTP10690_11	MYB-like proteins	tactagctGTTGttcac
RTP10690_12	VIP1 responsive elements	acacgGCTCag
RTP10690_12	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagg
RTP10690_12	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_12	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaacgcta
RTP10690_12	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_12	GT-box elements	gctgacGTTAcgtaacg
RTP10690_12	Cell-death specification 2	gttacGTAAcg
RTP10690_12	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_12	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_12	Cell-death specification 2	gttacGTAAcg
RTP10690_12	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_12	GT-box elements	cctagcGTTAcgtaacg
RTP10690_12	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacctagcgtTACGtaacgtca
RTP10690_12	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacctagcg
RTP10690_12	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcacgtgacg
RTP10690_12	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_12	Plant G-box/C-box bZIP proteins	ctaacgtcACGTgacgctacc
RTP10690_12	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_12	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_12	ABA response elements	taacgtcaCGTGacgct
RTP10690_12	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttagc
RTP10690_12	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttag

RTP10690_12	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_12	Plant G-box/C-box bZIP proteins	gttagctaACGTcacgtgacg
RTP10690_12	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttagctaacgtCACGtgacgcta
RTP10690_12	Opaque-2 like transcriptional activators	tagctaACGTcacgtga
RTP10690_12	Plant G-box/C-box bZIP proteins	gtcacgTGACgttagctaacg
RTP10690_12	MYB-like proteins	cacgtgacGTTAgctaa
RTP10690_12	Plant G-box/C-box bZIP proteins	ctcagcTGACgctacctagcg
RTP10690_12	Plant G-box/C-box bZIP proteins	gctaggtaGCGTcagctgagc
RTP10690_12	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgtcagctgagctTACGtaagcgct
RTP10690_12	Vertebrate TATA binding protein factor	gcttacgTAAGctcagc
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_12	Cell-death specification 2	cttacGTAAgc
RTP10690_12	Plant G-box/C-box bZIP proteins	aagcgcttACGTaagctcagc
RTP10690_12	Opaque-2 like transcriptional activators	gcgcttACGTaagctca
RTP10690_12	Cell-death specification 2	cttacGTAAgc
RTP10690_12	Plant G-box/C-box bZIP proteins	ctgagcttACGTaagcgctta
RTP10690_12	Opaque-2 like transcriptional activators	gagcttACGTaagcgct
RTP10690_12	Vertebrate TATA binding protein factor	gcttacgTAAGcgctta
RTP10690_12	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	ctttaattaagcgctTACGtaagctca
RTP10690_12	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	ttaattaagcgcttACGTaag
RTP10690_12	Vertebrate TATA binding protein factor	ctttaatTAAGcgctta
RTP10690_12	DNA binding with one finger (DOF)	gcttaattAAAGtactg
RTP10690_12	Arabidopsis homeobox protein	gtaCTGAtatc
RTP10690_12	Dehydration responsive element binding factors	atttggtaCCGAtatcagtac
RTP10690_12	SBP-domain proteins	tatcgGTACcaaatcga
RTP10690_12	Sucrose box	aaAAATtacggatatgaat
RTP10690_12	MYB proteins with single DNA binding repeat	attcatATCCgtaattt
RTP10690_5	M-phase-specific activator elements	attacAACGgtatat
RTP10690_5	Yeast TATA binding protein factor	aacggtaTATAtcctgc
RTP10690_5	Yeast TATA binding protein factor	ggcaggaTATAtaccgt
RTP10690_5	Vertebrate TATA binding protein factor	cggtaTATAtcctgcca

RTP10690_5	MYB proteins with single DNA binding repeat	gtatatATCCtgccagt
RTP10690_5	Caenorhabditis maternal gene product SKN-1	cagcATCAtcaca
RTP10690_5	Fungal and oomycete pathogen response cluster - promoter motif	ctattcGGGCctaactt
RTP10690_5	Retroviral upstream element	ggcccgaatagTTTGaaatta
RTP10690_5	SBP-domain proteins	tagcCGTAcaatattac
RTP10690_5	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	gtgagtaatattgtACGGcta
RTP10690_5	Arabidopsis homeobox protein	aatATTActca
RTP10690_5	Opaque-2 like transcriptional activators	accggTGAGtaatattg
RTP10690_5	Epstein-Barr virus transcription factor R	atgccccccatcgtaGGTGaa
RTP10690_5	Retroviral PolyA signal	gCCATtaatttccaccttcac
RTP10690_5	Retroviral upstream element	cgcgccattaaTTTCcacctt
RTP10690_5	L1 box, motif for L1 layer-specific expression	cgcCATTaatttccacc
RTP10690_5	Arabidopsis homeobox protein	gaaATTAatgg
RTP10690_5	GT-box elements	gtaataGTTActaatca
RTP10690_5	MYB-like proteins	acgtaatAGTTactaat
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	cactgattagtaactatTACGtaagcc
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	ctgattagtaactatTACGtaagccta
RTP10690_5	Cell-death specification 2	cttacGTAAta
RTP10690_5	Plant G-box/C-box bZIP proteins	gtaggcttACGTaatagttac
RTP10690_5	Cell-death specification 2	attacGTAAgc
RTP10690_5	Vertebrate TATA binding protein factor	tattacgTAAGcctacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacgtaggctTACGtaatagtt
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	actattacgtaagccTACGtagcgtca
RTP10690_5	Plant G-box/C-box bZIP proteins	gtaagcctACGTagcgtcacg
RTP10690_5	Opaque-2 like transcriptional activators	aagcctACGTagcgtca
RTP10690_5	Plant G-box/C-box bZIP proteins	gtcacgTGACgctacgtaggc
RTP10690_5	Plant G-box/C-box bZIP proteins	cctacgtaGCGTcacgtgacg
RTP10690_5	ABA response elements	tagcgtcaCGTGacgtt
RTP10690_5	Plant G-box/C-box bZIP proteins	ctaacgtcACGTgacgctacg
RTP10690_5	Myc-like basic helix-loop-helix binding factors	taacgtCACGtgacgctac
RTP10690_5	Opaque-2 like transcriptional activators	aacgtcACGTgacgcta
RTP10690_5	ABA response elements	taacgtcaCGTGacgct
RTP10690_5	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgacgttagc
RTP10690_5	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgacgttag
RTP10690_5	Opaque-2 like transcriptional activators	agcgtcACGTgacgtta
RTP10690_5	Plant G-box/C-box bZIP proteins	gttagctaACGTcacgtgacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttagctaacgtCACGtgacgcta
RTP10690_5	Opaque-2 like transcriptional activators	tagctaACGTcacgtga
RTP10690_5	Plant G-box/C-box bZIP proteins	gtcacgTGACgttagctaacg
RTP10690_5	MYB-like proteins	cacgtgacGTTAgctaa
RTP10690_5	Plant G-box/C-box bZIP proteins	ctgaggctACGTagcgttagc

RTP10690_5	Opaque-2 like transcriptional activators	gaggctACGTagcgtta
RTP10690_5	Opaque-2 like transcriptional activators	aacgctACGTagcctca
RTP10690_5	Plant G-box/C-box bZIP proteins	cttacgtaACGTcagctgagg
RTP10690_5	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaagc
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcctcagctgacgtTACGtaagcct a
RTP10690_5	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_5	GT-box elements	gctgacGTTAcgtaagc
RTP10690_5	Cell-death specification 2	cttacGTAAcg
RTP10690_5	Plant G-box/C-box bZIP proteins	gtaggcttACGTaacgtcagc
Spacer ID	**Detailed Family Information**	**Sequence**
RTP10690_5	Opaque-2 like transcriptional activators	aggcttACGTaacgtca
RTP10690_5	Cell-death specification 2	gttacGTAAgc
RTP10690_5	Plant G-box/C-box bZIP proteins	ctgacgttACGTaagcctacg
RTP10690_5	Opaque-2 like transcriptional activators	gacgttACGTaagccta
RTP10690_5	Vertebrate TATA binding protein factor	cgttacgTAAGcctacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctacgtaggctTACGtaacgtc a
RTP10690_5	Plant G-box/C-box bZIP proteins	gtaagcctACGTagcgtcacg
RTP10690_5	Opaque-2 like transcriptional activators	aagcctACGTagcgtca
RTP10690_5	Plant G-box/C-box bZIP proteins	ctcacgTGACgctacgtaggc
RTP10690_5	Plant G-box/C-box bZIP proteins	cctacgtaGCGTcacgtgagc
RTP10690_5	Plant G-box/C-box bZIP proteins	ctaagctcACGTgacgctacg
RTP10690_5	Myc-like basic helix-loop-helix binding factors	taagctCACGtgacgctac
RTP10690_5	Opaque-2 like transcriptional activators	aagctcACGTgacgcta
RTP10690_5	ABA response elements	taagctcaCGTGacgct
RTP10690_5	Plant G-box/C-box bZIP proteins	gtagcgtcACGTgagcttagc
RTP10690_5	Myc-like basic helix-loop-helix binding factors	tagcgtCACGtgagcttag
RTP10690_5	Opaque-2 like transcriptional activators	agcgtcACGTgagctta
RTP10690_5	GT-box elements	cgtcacGTGAgcttagc
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcgttagctaagctCACGtgacgct a
RTP10690_5	Plant G-box/C-box bZIP proteins	gttacgtaACGTcagctgagc
RTP10690_5	Plant G-box/C-box bZIP proteins	ctcagcTGACgttacgtaacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aggctcagctgacgtTACGtaacgct a
RTP10690_5	Opaque-2 like transcriptional activators	cagctgACGTtacgtaa
RTP10690_5	GT-box elements	gctgacGTTAcgtaacg
RTP10690_5	Cell-death specification 2	gttacGTAAcg
RTP10690_5	Plant G-box/C-box bZIP proteins	ctagcgttACGTaacgtcagc
RTP10690_5	Opaque-2 like transcriptional activators	agcgttACGTaacgtca
RTP10690_5	Cell-death specification 2	gttacGTAAcg
RTP10690_5	Opaque-2 like transcriptional activators	gacgttACGTaacgcta
RTP10690_5	GT-box elements	gctagcGTTAcgtaacg
RTP10690_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gacgctagctagcgtTACGtaacgtc a
RTP10690_5	Plant G-box/C-box bZIP proteins	caggagTGACgctagctagcg
RTP10690_5	Plant G-box/C-box bZIP proteins	gctagctaGCGTcactcctgc
RTP10690_5	Enhancer element first identified in the promoter of the octopine synthase gene (OCS) of the Agrobacterium tumefaciens T-DNA	ttgctgcaggagtGACGctag
t-AtAHASL	Retroviral PolyA signal	aCCATaaaaggttctgataat

t-AtAHASL	Vertebrate TATA binding protein factor	gaccaTAAAaggttctg
t-AtAHASL	Papillioma virus E2 transcriptional activator	agaccataaaAGGTtct
Spacer ID	**Detailed Family Information**	**Sequence**
t-AtAHASL	MADS box proteins	aaagaccatAAAAggttctga
t-AtAHASL	Papillioma virus E2 transcriptional activator	gaacctttta TGGTctt
t-AtAHASL	GT-box elements	ttttATGGtctttgtat
t-AtAHASL	MYB proteins with single DNA binding repeat	taccaTATGcatacaaa
t-AtAHASL	Arabidopsis homeobox protein	aaaCTTAgttt
t-AtAHASL	MYB-like proteins	aaaactTAGTttgcaat
t-AtAHASL	GT-box elements	gttttgGTAAtttgagt
t-AtAHASL	MYB-like proteins	ttcttttAGTTgttgat
t-AtAHASL	Retroviral CCAAT binding factors	aCCAAaaagcaggcagatcaacaac
t-AtAHASL	Sucrose box	aaAAAGcaggcagatcaac
t-AtAHASL	Legumin Box family	ttgatctGCCTgctttttggtttacgt
t-AtAHASL	DNA binding with one finger (DOF)	taaaccaaAAAGcaggc
t-AtAHASL	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	gcctgctttttggttTACGtcagacta
t-AtAHASL	Cell-death specification 2	ctgacGTAAac
t-AtAHASL	Plant G-box/C-box bZIP proteins	gtagtcTGACgtaaaccaaaa
t-AtAHASL	Cell-death specification 2	tttacGTCAga
t-AtAHASL	Plant G-box/C-box bZIP proteins	tttggtttACGTcagactact
t-AtAHASL	Plant G-box/C-box bZIP proteins	gcagtagtagtcTGACgtaaa
t-AtAHASL	Secondary wall NACS	tttataaaatgAAAGaaag
t-AtAHASL	Core promoter initiator elements	ttTCATtttat
t-AtAHASL	Vertebrate TATA binding protein factor	atttaTAAAatgaaaga
t-AtAHASL	Plant TATA binding protein factor	atttTATAaataaat
t-AtAHASL	Vertebrate TATA binding protein factor	ttttaTAAAtaaataat
t-AtAHASL	L1 box, motif for L1 layer-specific expression	tataaaTAAAtaatccg
t-AtAHASL	Retroviral PolyA signal	ataaaTAAAtaatccggttcg
t-AtAHASL	Dehydration responsive element binding factors	ggagtaaaCCGAaccggatta
t-AtAHASL	MYB-like proteins	tcagtttgGTTAttgcg
t-AtAHASL	GT-box elements	agtttgGTTAttgcgaa
t-AtAHASL	Cell-death specification 2	atttcGCAAta
t-AtAHASL	Cell-death specification 2	attgcGAAAtg
t-AtAHASL	Plant nitrate-responsive cis-elements	tcaatttaccattcgcatttcgcAATA accaaa
t-AtAHASL	TEF-box	gaATGGtaaattgagtaattg
t-AtAHASL	Cell-death specification 2	attgaGTAAtt
t-AtAHASL	MYB-like proteins	tgaaatTCGTtattagg
t-AtAHASL	Telo box (plant interstitial telomere motifs)	tagaaCCCTaataac
t-AtAHASL	Mitochondral HMG-box transcription factor	attagggTTCTaa
t-AtAHASL	VIP1 responsive elements	aaacaGCTTag
t-AtAHASL	CA-rich motif	ctgttaaAACAgcttagaa
t-AtAHASL	MYB-like proteins	cagtgaCTGTtaaaaca
t-AtAHASL	GT-box elements	cactggGTTAatatctc
t-AtAHASL	Circadian control factors	tgggttAATAtctct
t-AtAHASL	Myb-related DNA binding proteins (Golden2, ARR, Psr)	AGATtcgag
Spacer ID	**Detailed Family Information**	**Sequence**
t-AtAHASL	Legumin Box family	gcattttcCATGcaagattcgagagat
t-AtAHASL	GT-box elements	ttgcATGGaaaatgctc
t-AtAHASL	Retroviral upstream element	ggtaagagcatTTTCcatgca

t-AtAHASL	Mitochondral HMG-box transcription factor	aagagcaTTTTcc
t-AtAHASL	MYB proteins with single DNA binding repeat	tggaAAATgctcttacc
t-AtAHASL	LFY binding site	aACCAatggtaag
t-AtAHASL	CCAAT binding factors	aaCCAAtgg
t-AtAHASL	LFY binding site	tACCAttggtttt
t-AtAHASL	Retroviral PolyA signal	ttcaaTTAAaaaccaatggta
t-AtAHASL	Soybean embryo factor 4	ggTTTTtaatt
t-AtAHASL	DNA-binding proteins with the plant specific TCP-domain	cacgGCCCatatg
t-AtAHASL	Root hair-specific cis-elements in angiosperms	atttaatttggaaacCACGgcccat
t-AtAHASL	MADS box proteins	ggtTTCCaaattaaataaaac
t-AtAHASL	Vertebrate TATA binding protein factor	ttttattTAATttggaa
t-AtAHASL	Sulphur limitation, elements found in genes inducible during sulphur deprivation	agtttTATTtaatttggaaac
t-AtAHASL	High mobility group factors	gtttTATTtaatttg
t-AtAHASL	L1 box, motif for L1 layer-specific expression	ccaaatTAAAtaaaact
t-AtAHASL	Retroviral PolyA signal	ttaaaTAAAactacgatgtca
t-AtAHASL	Opaque-2 like transcriptional activators	actacgatgTCATcgag
t-AtAHASL	Caenorhabditis maternal gene product SKN-1	cgatGTCAtcgag
t-AtAHASL	Sucrose box	taAAATcaactgtgtccac
t-AtAHASL	Lentiviral Poly A downstream element	aaCTGTgtccacatt
t-AtAHASL	MYB-like proteins	acaaaactGATAatgtg
t-AtAHASL	Retroviral upstream element	cacattatcagTTTTgtgtat
t-AtAHASL	Core promoter initiator elements	taTCAGttttg
t-AtAHASL	GT-box elements	aataggGTAAttcaaaa
t-AtAHASL	Circadian control factors	taattcaaAATCtag
t-AtAHASL	Lentiviral Tata upstream element	aaggttaaaatgAACCaaaaggc
t-AtAHASL	GT-box elements	cagaaggTTAAaatgaa
t-AtAHASL	Heat shock factors	tttaacCTTCtgtaaac
t-AtAHASL	Nodulin consensus sequence 1	aAAATgtttac
t-AtAHASL	Circadian control factors	ttgttcaaAATCtga
t-AtAHASL	L1 box, motif for L1 layer-specific expression	aacaagTAAAtccaaaa
t-AtAHASL	Circadian control factors	aaaaaaaaAATCtca
t-AtAHASL	Mitochondral HMG-box transcription factor	ttgagatTTTTtt
t-AtAHASL	Arabidopsis homeobox protein	taaTTTAgtgt
t-AtAHASL	L1 box, motif for L1 layer-specific expression	caaCACTaaattatttt
t-AtAHASL	Storekeeper motif	cacTAAAttatttta
t-AtAHASL	Arabidopsis homeobox protein	aaaATAAttta
t-AtAHASL	Arabidopsis homeobox protein	taaATTAtttt
t-AtAHASL	Arabidopsis homeobox protein	tatttTAATgt
t-AtAHASL	Vertebrate TATA binding protein factor	atgtaTAAAagatgctt
t-AtAHASL	Nodulin consensus sequence 1	tAAAAgatgct
t-AtAHASL	Storekeeper motif	gctTAAAacatttgg
t-AtAHASL	Myc-like basic helix-loop-helix binding factors	ttaaaACATttggcttaaa
Spacer ID	**Detailed Family Information**	**Sequence**
t-AtAHASL	Sucrose box	ttAAAAcatttggcttaaa
t-AtAHASL	Secondary wall NACS	catttggcttaAAAGaaag
t-AtAHASL	Tracheary-element-regulating cis-elements, conferring TE-specific expression	cttaAAAGaaa
t-AtAHASL	Heat shock factors	taaaaacatagAGAAct
t-AtAHASL	DNA binding with one finger (DOF)	actcttgtAAATtgaag
t-AtAHASL	MYB proteins with single DNA binding repeat	cagtATATtttcatact
t-AtAHASL	MADS box proteins	taataCCCAattcagtatatt
t-AtAHASL	MADS box proteins	ataTACTgaattgggtattat

t-AtAHASL	CCAAT binding factors	acCCAAttc
t-AtAHASL	Sucrose box	ctAAATcagaaaaattcat
t-AtAHASL	MADS box proteins	tgaatcctaaatcaGAAAaat
LJB2197_5	M-phase-specific activator elements	ggacgAACGgataaa
LJB2197_5	MYB proteins with single DNA binding repeat	aggtttATCCgttcgtc
LJB2197_5	Nodulin consensus sequence 1	gAAAAggttta
LJB2197_5	DNA binding with one finger (DOF)	gggcgtgaAAAGgttta
LJB2197_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	acggataaaccttttCACGcccttta
LJB2197_5	E2F-homolog cell cycle regulators	ccttTTCAcgccctt
LJB2197_5	Transposase-derived transcription factors	ttttCACGcccttttaa
LJB2197_5	Vertebrate TATA binding protein factor	atattTAAAagggcgtg
LJB2197_5	DNA binding with one finger (DOF)	gatatttaAAAGggcgt
LJB2197_5	Vertebrate TATA binding protein factor	cctttTAAAtatccgat
LJB2197_5	Arabidopsis homeobox protein	ccgATTAttct
LJB2197_5	Retroviral PolyA signal	tctaaTAAAcgctcttttctc
LJB2197_5	Retroviral CCAAT binding factors	tCTAAtaaacgctcttttctcttag
LJB2197_5	DNA binding with one finger (DOF)	ctaagagaAAAGagcgt
LJB2197_5	Nodulin consensus sequence 2	tcttttCTCTtaggt
LJB2197_5	Ethylen respone element factors	gGCGGgtaaacctaagaga
LJB2197_5	DNA binding with one finger (DOF)	tggcgggtAAACctaag
LJB2197_5	MYB proteins with single DNA binding repeat	caggATATattggcggg
LJB2197_5	MYB proteins with single DNA binding repeat	caatatATCCtgtcaaa
LJB2197_5	TALE (3-aa acid loop extension) class homeodomain proteins	tttGACAggatat
LJB2197_5	W Box family	agtgtTTGAcaggatat
LJB2197_5	E2F-homolog cell cycle regulators	tcgtTTCCcgccttc
LJB2197_5	Circadian control factors	gaaacgacAATCtga
LJB2197_5	MYB-like proteins	aggcctTAGTtactaat
LJB2197_5	Vertebrate TATA binding protein factor	tagtaacTAAGgccttt
LJB2197_5	Retroviral PolyA signal	attaaTTAAaggccttagtta
LJB2197_5	DNA binding with one finger (DOF)	gattaattAAAGgcctt
LJB2197_5	Arabidopsis homeobox protein	ttaatTAATct
LJB2197_5	Arabidopsis homeobox protein	tagATTAatta
LJB2197_5	Light responsive element motif, not modulated by different light qualities	taATCTagagg
Spacer ID	**Detailed Family Information**	**Sequence**
LJB2197_5	Vertebrate TATA binding protein factor	caattTAAAttggccgg
LJB2197_5	L1 box, motif for L1 layer-specific expression	tcaattTAAAttggccg
LJB2197_5	Retroviral upstream element	accgatatcaaTTTAaattgg
LJB2197_5	MYB proteins with single DNA binding repeat	accgaTATCaatttaaa
LJB2197_5	Dehydration responsive element binding factors	tcgatgtaCCGAtatcaattt
LJB2197_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	tatcggtacatcgatTACGccaagct a
LJB2197_5	Cell-death specification 2	ttggcGTAAtc
LJB2197_5	MADS box proteins	cttTTCTatacaaagttgata
LJB2197_5	Plant TATA binding protein factor	tttcTATAcaaagtt
LJB2197_5	Pollen-specific regulatory elements	gtataGAAAagttgcca
LJB2197_5	GT-box elements	aatcATGGcaacttttc
LJB2197_5	Arabidopsis homeobox protein	gtaATCAtggc
LJB2197_5	Arabidopsis homeobox protein	gccatgATTAc

LJB2197_5	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	aaaagttgccatgatTACGccaagct t
LJB2197_5	Cell-death specification 2	ttggcGTAAtc
LJB2197_5	Calcium regulated NAC-factors	ccaaGCTTggccactaaggcc
LJB2197_5	E2F-homolog cell cycle regulators	caatTTCGcgccctg
LJB2197_1	Arabidopsis homeobox protein	caaTTTActga
LJB2197_1	Motifs of plastid response elements	cacgCGATcgcgtcgacacaatcagt aaatt
LJB2197_1	Calmodulin binding / CGCG box binding proteins	gatCGCGtcgacacaat
LJB2197_1	Core promoter motif ten elements	gcacgcgATCGcgtcgacaca
LJB2197_1	Calmodulin binding / CGCG box binding proteins	gatCGCGtgcaaacact
LJB2197_1	Root hair-specific cis-elements in angiosperms	tccgtacagtgtttgCACGcgatcg
LJB2197_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	ggtccgtacagtgtttgCACGcgatcg
LJB2197_1	SBP-domain proteins	ggtcCGTAcagtgtttg
LJB2197_1	SBP-domain proteins	ggccgGTACccaagttt
LJB2197_1	SBP-domain proteins	agtttGTACaaaaaagc
LJB2197_1	DNA binding with one finger (DOF)	tgtacaaaAAAGcaggc
LJB2197_1	Legumin Box family	caaaaaaGCAGgctccatgattacgc c
LJB2197_1	Arabidopsis homeobox protein	tccatgATTAc
LJB2197_1	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	agcaggctccatgatTACGccaagct t
LJB2197_1	Cell-death specification 2	ttggcGTAAtc
LJB2197_1	Calcium regulated NAC-factors	ccaaGCTTggccactaaggcc
Spacer ID	**Detailed Family Information**	**Sequence**
LJB2197_1	L1 box, motif for L1 layer-specific expression	tagattTAAAttggcct
LJB2197_1	Circadian control factors	ccaatttaAATCtac
LJB2197_1	Vertebrate TATA binding protein factor	caattTAAAtctactag
LJB2197_1	Light responsive element motif, not modulated by different light qualities	aaATCTactag
LJB2197_2	E2F-homolog cell cycle regulators	gtaaTTCCcgggatt
LJB2197_2	Brassinosteroid (BR) response element	ctgcccCGTGtggccggc
LJB2197_3	Core promoter initiator elements	ttTCATtcggt
LJB2197_3	Retroviral upstream element	ggcgccatcggTTTCattcgg
LJB2197_3	Papillioma virus E2 transcriptional activator	ggaccgatacCGGTagg
LJB2197_3	Papillioma virus E2 transcriptional activator	ctaccggtatCGGTccg
LJB2197_3	Dehydration responsive element binding factors	caatcggaCCGAtaccggtag
LJB2197_3	Core promoter motif ten elements	ggccgcaATCGgaccgatacc
LJB2197_3	TEF-box	taAAGGgcgaattcgtttaaa
LJB2197_3	SBP-domain proteins	ggtcCGTAcagtgttta
LJB2197_3	Activator-, mediator- and TBP-dependent core promoter element for RNA polymerase II transcription from TATA-less promoters	ggGTGGtaccg
LJB2197_3	SBP-domain proteins	ggccgGTACcacccagc
LJB2197_3	Soybean embryo factor 3	gtaccACCCagcttt
LJB2197_3	Arabidopsis homeobox protein	gtaATCAtggc

LJB2197_3	Arabidopsis homeobox protein	gccatgATTAc
LJB2197_3	Plant specific NAC [NAM (no apical meristem), ATAF172, CUC2 (cup-shaped cotyledons 2)] transcription factors	caaagtggccatgatTACGccaagct t
LJB2197_3	Cell-death specification 2	ttggcGTAAtc
LJB2197_3	Calcium regulated NAC-factors	ccaaGCTTggccactaaggcc
LJB2197_3	L1 box, motif for L1 layer-specific expression	tagattTAAAttggcct
LJB2197_3	Circadian control factors	ccaatttaAATCtac
LJB2197_3	Vertebrate TATA binding protein factor	caattTAAAtctactag
LJB2197_3	Light responsive element motif, not modulated by different light qualities	aaATCTactag
LJB2197_3	MYB IIG-type binding sites	aatgGGTAggtcatc
LJB2197_4	E2F-homolog cell cycle regulators	gtaaTTCCcgggatt

Of particular note in Table 172 was the surprisingly high number of sequences that contain abscisic acid related transcription factor binding motifs for the construct VC-RTP10690-1qcz_F. Abscisic acid was a plant hormone involved in seed maturation, desiccation, and stress response, see Cutler et al. (2010) for a comprehensive review. Based upon what was known about abscisic acid and its effect on seed maturation, the observed high number of motifs implicated in the regulation of gene expression in response to abscisic acid may have played a role in the observed transcript levels and timing of gene expression for the genes in VC-RTP10690-1qcz_F. In addition to the likely affects on transcription, it is also known in the literature that topography is affected by GC content (see Wachter et al., 2014) and it is prudent to have a GC content in the T-DNA matching that of the host as much as possible. In addition to reducing the possibility of deletions and rearrangements, reducing the amount of repeats would also impact DNA topography and gene regulation (Ramamoorthy et al. 2014). The spacer regions would contribute to the overall impact of the T-DNA upon the local chromatin structure, which in turn will impact how the genes in that region are regulated and transcribed (Parker et al. 2009, Meggendorfer et al. 2010).

Example 24 Gene Expression, Copy number determination and event detection

Plant material representing wild type, the BiBAC VC-RTP10690-1qcz_F, and the co-transformation constructs: VC-LJB2197-1qcz with VC-LLM337-1qcz rc, VC-LJB2755-2qcz rc with VC-LLM391-2qcz rc and VC-LJB2755-2qcz rc with VC-LTM217-1qcz rc were harvested according to the date after pollination. Construct details (genes and promoters) are found in Table 1, Table 2, Table 4, Table 6, Table 7 and Table 8. Based on the day after pollination, which correlated with developmental stage under the growth conditions employed, the seeds were combined into pools. The pooled seeds were immediately frozen in liquid nitrogen and subsequently stored at -80° C. A third of the frozen immature seeds were homogenized using the Precelly®24-Dual technology in 7ml tubes and two ceramic beads (6500Hz, 2-3 times, 20sec). From each pool three aliquots of 50-70mg of tissue were used to isolate the RNA. Frozen tissue was ground to a fine powder and extracted following basic procedures familiar to one who was skilled in the art (see Ruuska et al. 2000 and Focks and Benning, 1998 as well as Sambrook et al.1989 for an overview on RNA extraction from immature seeds and sample and RNA handling). RNA was extracted according to the protocol “SG-MA_0007-2009 RNA isolation” using Spectrum Plant Total RNA-KIT part number STRN50 (SIGMA-ALDRICH GmbH, Munich, Germany). In average the concentration of total RNA was about 450ng/µl. The 260/280 ratio was at 2.2 and the 260/230 ratio at 2.3.

For cDNA synthesis for qPCR 1µg of total RNA was treated with DNAseI (DEOXYRIBUNUCLEASE I (AMP-D1, Amplification Grade from SIGMA-Aldrich, GmbH) according to the supplier's protocol. After DNAseI treatment, the reverse transcription reaction was performed with the SuperScript™ III First-Strand Synthesis SuperMix for qRT-PCR (Invitrogen, Cat. No. 11752-250) and with a combination of oligo dT and random hexamers to ensure thorough and even representation of all transcripts, regardless of length.

Quantitative real time pcr protocol

Transcript measurement by quantitative real time PCR was carried out using procedures considered standard to those skilled in the art; see Livak and Schmittgen (2001). The qPCR reactions were done as simplex TaqMan reactions. The endogenous reference gene was isolated in house and used due to predicted stability of the transcript based on the observed stability of the transcript corresponding to the orthologue in *Arabidopsis thaliana* during development. The canola ortholog was isolated and the gene, SEQ ID, was part of the glycosyl-phosphatidylinositol aminotransferase pathway (GPI). The cDNA reactions, described above, were diluted 1:4. 2µl cDNA, which corresponded to 25ng of total RNA, was used per 10µl qPCR reaction with JumpStart TAQ ReadyMix (P2893-400RXN Sigma-Aldrich, GmbH). Primer/probe concentrations were 900 nmol for forward and reverse primer and 100nmol TaqMan probe. The TaqMan probes for targets of interest were labeled with FAM/BHQ1, and the reference gene was labeled with Yakima Yellow/BHQ1.

Each qPCR assay included a 1:1 dilution curve (5 dilution steps) with cDNA from the pool VC-RTP10690-1qcz_F, a no template control, three -RT controls (VC-RTP10690-1qcz_F, VC-LTM593-1qcz rc (~4w) and co-transformation VC-LJB2197-1qcz + VC-LLM337-1qcz rc). From each pool three independent aliquots of cDNA were measured as technical repeats. The ABI PRISM® 7900 sequence detection system (Applied Biosystem) was used with the following PCR Conditions:

Initial denaturation	95°C for 300 seconds	1 cycle
Amplification	95°C for 15 seconds/60°C for 60 seconds	repate for 40 cycles

The raw data were the Ct values for the target and the endogenous reference gene, respectively. The dCt values were calculated by subtraction: Ct(GOI)-Ct(Ref). The Reference dCt value was set to equal zero, which was interpreted as meaning that if there was no difference between GPI and the gene of interest (dCt = 0) the expression was = 1. The fold expression was equal to 2^{-dCt} (where the dCt = (Ct(GOI)-Ct(Ref)-0)). Three samples from each pool were taken and the geomean as well as the geometric positive and negative deviation were calculated. The slopes of

dilution curves were calculated for each gene of interest and the endogenous reference gene (GPI) as a measure for the amplification efficiency. Table 173,
Table 174 and Table 175 indicate the probes and primers used to amplify the genes for qPCR assays.

Table 173: Probes used in the qPCR reactions

Target of Interest	Probe	Probe Oligo
c-o3DES(Pi_GA2)	o3DES-594FAM	CGCTCACTTCTTCGTTGCTGGACTCTC
c-o3Des(Pir_GA)	o3DESPIR-198FAM	ATCATCTCTCTCGGAGTTC
c-o3Des(Pir_GA) 3'	o3DESPIR-962FAM	CGCTGCTCCTATCATCCCAACTTTCTTCA
j-o3DES(PIR_GA)/t-AtPXR	AtPXR-Fam	TCGACCTAGAGGATCCCCGGCC
j-BnSETLprom/o3DES(PIR_GA)	BnSETL-1186FAM	CTCTGCCAGCGACCAAATCGAAGC
j-o3DES(PIR_GA)/t-BnSETL	BnSETL-Fam	CCTTGTGTTAGTTTAATG
c-d5Elo(Ot_GA3)	E011	TGACAAACAAGCCACCAAGCCCAA
c-d4DES(TC_GA)	D4DES-Tc-FAM	TGCTTCCCCAATGTACGTTGCTAGGTTCT
c-d4Des(Eg_GA)	D4DES-Eg-FAM	AAGGCACATCCTCC
c-d4Des(Pl_GA2)	D4DES-Pl-770FAM	AGCTTCTTTTCTTGGACGCCCTTGAGC
GPI	Exp3-78-YAK	GGATTCGACATTCCATCGGCTTTGA

Table 174: Forward primers used in qPCR

Target of Interest	Forward Primer	Forward Primer Oligo
c-o3DES(Pi_GA2)	o3DES-572F	CCGCTGTGGTTATCTCTTTGC
c-o3Des(Pir_GA)	o3DESPIR-160F	CTTGGGAGGCTATGTATGTTAGAAGA
c-o3Des(Pir_GA) 3'	o3DESPIR-924F	GCTTTCCCTGAGCTTGTTAGGA
j-o3DES(PIR_GA)/t-AtPXR	o3DesPir-F	GGAGGCTAAGGCTGCTGCTA
j-BnSETLprom/o3DES(PIR_GA)	BnSETL-1164-F	GACCCCCTCTCTCTCGTTGTC
j-o3DES(PIR_GA)/t-BnSETL	BnSETL-1164-F	GACCCCCTCTCTCTCGTTGTC

Target of Interest	Forward Primer	Forward Primer Oligo
c-d5Elo(Ot_GA3)	MA54	GCAATCGTTGGTAGCCATGA
c-d4DES(TC_GA)	D4DES-Tc-F	CAAATCGATGCTGAGTGCAGAT
c-d4Des(Eg_GA)	D4DES-EG-F	TGACAAGTAAGCCATCCGTCAGT
c-d4Des(Pl_GA2)	D4DES-Pl-746-F	CTGGTGAGGCTATGTACGCTTTT
GPI	Exp 3-52F	GATGAATATCCTCCTGATGCTAACC

Table 175: Reverse primers used for qPCR

Target of Interest	Reverse Primer	Reverse Primer Oligo
c-o3DES(Pi_GA2)	o3DES-652R	TCTTAAGTCCCAACTGGAGAGACA
c-o3Des(Pir_GA)	o3DESPIR-262R	AAACCAAGGAGCGTCAAGTCTAGA
c-o3Des(Pir_GA) 3'	o3DESPIR-1026-R	TCAACAACTCCGTACTTAGCGTACAT
j-o3DES(PIR_GA)/t-AtPXR	AtPXR-R	TGCATGTACGTTATATAGTAGGCTTTTG
j-BnSETLprom/o3DES(PIR_GA)	o3DESPIR-R	GCAGATGTAGAAGCCATGGTTTG
j-o3DES(PIR_GA)/t-BnSETL	o3DESPIR-R	GCAGATGTAGAAGCCATGGTTTG
c-d5Elo(Ot_GA3)	MA55	CGTGTACCACCACGCTTTGT
c-d4DES(TC_GA)	D4DES-Tc-988R	AACACGGTCAAAGCCTTCATAATC
c-d4Des(Eg_GA)	D4DES-Eg-R	ACTTTTCACCACCGACGAAGTT
c-d4Des(Pl_GA2)	D4DES-Pl-817R	CCTCCCACCTCCAAGCAA
GPI	Exp 3-128R	CTTGCATGATGATCAGGAAAGC

Transcript analysis of a time course for gene expression of the BiBAC and co-transformations.

Transformants from four constructs were assayed as described above and transcript abundance relative to a single standard was measured as described, following standard protocols known to those skilled in the art as well as instructions provided with the kits employed. The graphs in Figure 16, Figure 17, Figure 18, Figure 19, Figure 20 and Figure 21 represent abundance of the gene listed over time with the error represented by the geometric positive and negative deviation. The time was listed on the abscissa and represents days after pollination and the ordinate

contains the expression of the gene of interest relative to an internal standard (canola GPI). Lines with two constructs listed represent co-transformation events.
The gene o3Des(Pi_GA2) driven by the VfUSP promoter with the CaMV35S terminator was present in VC-LJB2755-2qcz, VC-LLM337-1qcz rc and VC-RTP10960-1qcz_F. One observes in Figure 16 that VC-RTP10960-1qcz_F has relatively low transcript accumulation while the co-transformation combination of VC-LJB2755-2qcz and VC-LLM391-2qcz rc contains the highest accumulation of transcript from the gene o3Des(Pi_GA2). The overall trend for this transcript with the promoter, terminator, intron and spacer region in front of the promoter was to increase over seed development.

The gene d4Des(Pl_GA)2 driven by the LuCnl promoter with the AgrOCS 192bp[LED12] terminator was present in both VC-LTM217-1qcz rc and in VC-RTP10960-1qcz_F. One observes in Figure 19 for both constructs that the accumulation relative to the GPI reference was in the range of 4-12 fold with gradual accumulation over seed development, with VC-RTP10960-1qcz_F accumulating less than VC-LTM217-1qcz rc.

The o3Des(Pir_GA) gene was present in VC-LJB2755-2qcz and VC-RTP10960-1qcz_F driven by the LuCnl promoter with the AtPXR 400bp[LLL823] terminator while it was present in VC-LLM337-1qcz rc driven by the VfSBP_perm3 promoter with the StCATHD-pA terminator. Within error it was difficult to ascribe a pattern to any of the constructs, but as shown in Figure 17, single copy events of the construct combination VC-LJB2755-2qcz and VC-LLM391-2qcz had a peak towards seed maturation that was not observed with any of the other constructs. An additional copy of the gene driven by the BnSETL promoter and terminated by the BnSETL terminator was present in RTP10960-1qcz_F. However, similar to the d5Des(Tc_GA2) gene controlled by the same set of control elements, the o3Des(Pir_GA) copy under control of the p-BnSETL promoter was expressed at lower levels than the other genes with different control elements (Figure 18).

The gene d4Des(Tc_GA) was contained in VC-LLM337-1qcz rc, RTP10960-1qcz_F and VC-LTM217-1qcz rc and was driven by the ARC5_perm1 promoter with the pvarc terminator. A single point mutant of this gene; d4Des(Tc_GA)_T564G was contained in VC-LLM391-2qcz rc and regulated by the ARC5_perm1 promoter with the pvarc terminator. The overall trend of expression with this spacer region, promoter and terminator combination was an increase over seed development and then a decrease towards seed maturation, as depicted in Figure 20. Interestingly, the construct pair VC-LJB2755-2qcz with VC-LLM391-2qcz rc did not adhere to this trend but rather continued to increase over seed development and had a more robust expression than the other constructs and construct combinations. As previously observed VC-RTP10960-1qcz_F had the lowest level of expression.

VC-LLM337-1qcz rc and VC-LLM391-2qcz rc contain d4Des(Eg_GA) driven by the LuCnl promoter with the AgrOCS 192bp[LED12] terminator. It can be seen in Figure 21, that similar expression levels that increased during seed development where observed of single copy events containing either one of these two constructs.

Copy Number

To assess whether the entire pathway for PUFA biosynthesis was being brought into the plant and to what extent duplication and/or deletion was occurring in selected events; copy number analysis of certain genes along the T-DNA was carried out.

DNA extraction

Brown spotted immature seeds from three events were analyzed, in addition to cotyledons of germinating seedlings of two further events. The gDNA was isolated according to standard protocols consistent with Sambrook et al., 1982. To isolate plant tissue DNA the Wizard Magnetic 96 DNA Plant System was used (Promega, Madison, WI USA part number FF3760). The supplied protocols were followed with the listed changes being implemented in order to increase the amount of extracted DNA: the volume of the extraction buffer was increased to two hundred microliters and the volume of beads used was increased to ninety microliters with the volume of elution buffer being decreased to twenty microliters.

Duplex qPCR reactions were performed using JumpStart TaqReadyMix for Quantitative PCR (Sigma, D7440). qPCR assays were validated according to standard protocols for qPCR, see Demeke and Jenkins (2010) and Livak and Schmittgen (2001). The genomic copy numbers were calculated with the ddCt method based on the mean of the reference dCt value of a pool of known single copy events. Using the Excel function “frequency”, groups of 0, 1, 2, 3, >4 were counted both target and event wise. A Chi-square test was performed for testing the hypothesis the family was segregating for a single T-DNA. The cutoff of P value was set at > 0.0499 for a single T-DNA segregation.

PCR for copy number analysis was carried out using the primers and probes listed and according to standard protocols used by those skilled in the art, see Livak and Schmittgen (2001) and Demekes T. and Jenkins RG (2010).

The primer pairs and probes are listed by name below and sequences can be found in the sequence listing:

Target	**Forward Primer**	**Reverse Primer**	**Probe**
c-AHAS	c-AHAS_F	c-AHAS_R	c-AHAS_P
c-d4Des(Eg_GA)	c-d4Des(Eg_GA)_F	c-d4Des(Eg_GA)_R	c-d4Des(Eg_GA)_P
c-d4Des(Pl_GA)2	c-d4Des(Pl_GA)2_F	c-d4Des(Pl_GA)2_R	c-d4Des(Pl_GA)2_P
c-d4Des(Tc_GA)	c-d4Des(Tc_GA)_F	c-d4Des(Tc_GA)_R	c-d4Des(Tc_GA)_P
c-d5Des(Tc_GA)	c-d5Des(Tc_GA)_F	c-d5Des(Tc_GA)_R	c-d5Des(Tc_GA)_P
c-d5Elo(Ot_GA3)	c-d5Elo(Ot_GA3)_F	c-d5Elo(Ot_GA3)_R	c-d5Elo(Ot_GA3)_P
c-d6Des(Ot_febit)	c-d6Des(Ot_febit)_F	c-d6Des(Ot_febit)_R	c-d6Des(Ot_febit)_P
c-d6Elo(Pp_GA)	c-d6Elo(Pp_GA)_F	c-d6Elo(Pp_GA)_R	c-d6Elo(Pp_GA)_P
c-d6Elo(Tp_GA)	c-d6Elo(Tp_GA)_F	c-d6Elo(Tp_GA)_R	c-d6Elo(Tp_GA)_P
c-o3Des(Pi_GA)	c-o3Des(Pi_GA)_F	c-o3Des(Pi_GA)_R	c-o3Des(Pi_GA)_P

Target	Forward Primer	Reverse Primer	Probe
c-o3Des(Pir_GA)	c-o3Des(Pir_GA)_F	c-o3Des(Pir_GA)_R	c-o3Des(Pir_GA)_P
j-i-Atss1_c-d5Elo(Ot_GA3)	j-i-Atss1_c-d5Elo(Ot_GA3)_F	j-i-Atss1_c-d5Elo(Ot_GA3)_R	j-i-Atss1_c-d5Elo(Ot_GA3)_P
j-i-Atss1_c-d6Elo(Tp_GA2)	j-i-Atss1_c-d6Elo(Tp_GA2)_F	j-i-Atss1_c-d6Elo(Tp_GA2)_R	j-i-Atss1_c-d6Elo(Tp_GA2)_P
j-i-Atss14_c-d12Des(Ps_GA)	j-i-Atss14_c-d12Des(Ps_GA)_F	j-i-Atss14_c-d12Des(Ps_GA)_R	j-i-Atss14_c-d12Des(Ps_GA)_P
j-i-Atss18_c-d6Elo(Pp_GA2)	j-i-Atss18_c-d6Elo(Pp_GA2)_F	j-i-Atss18_c-d6Elo(Pp_GA2)_R	j-i-Atss18_c-d6Elo(Pp_GA2)_P
j-i-Atss18_c-o3Des(Pi_GA2)	j-i-Atss18_c-o3Des(Pi_GA2)_F	j-i-Atss18_c-o3Des(Pi_GA2)_R	j-i-Atss18_c-o3Des(Pi_GA2)_P
j-i-Atss2_c-d4Des(Tc_GA3)	j-i-Atss2_c-d4Des(Tc_GA3)_F	j-i-Atss2_c-d4Des(Tc_GA3)_R	j-i-Atss2_c-d4Des(Tc_GA3)_P
j-i-Atss2_c-d6Des(Ot febit_GA)	j-i-Atss2_c-d6Des(Ot febit_GA)_F	j-i-Atss2_c-d6Des(Ot febit_GA)_R	j-i-Atss2_c-d6Des(Ot febit_GA)_P
j-p-BnFAE_ t-PvARC	j-p-BnFAE_ t-PvARC_F	j-p-BnFAE_ t-PvARC_R	j-p-BnFAE_ t-PvARC_P
j-p-BnSETL-v1_c-o3Des(Pir_GA)	j-p-BnSETL-v1_c-o3Des(Pir_GA)_F	j-p-BnSETL-v1_c-o3Des(Pir_GA)_R	j-p-BnSETL-v1_c-o3Des(Pir_GA)_P
j-p-LuPXR_i-Atss15	j-p-LuPXR_i-Atss15_F	j-p-LuPXR_i-Atss15_R	j-p-LuPXR_i-Atss15_P
j-p-PvARC5_t-BnFAE	j-p-PvARC5_t-BnFAE_F	j-p-PvARC5_t-BnFAE_R	j-p-PvARC5_t-BnFAE_P
j-p-PvARC5_t-BnSETL	j-p-PvARC5_t-BnSETL_F	j-p-PvARC5_t-BnSETL_R	j-p-PvARC5_t-BnSETL_P
j-t-CaMV_p-LuCnl-2	j-t-CaMV_p-LuCnl-2_F	j-t-CaMV_p-LuCnl-2_R	j-t-CaMV_p-LuCnl-2_P
j-t-E9-p3-2	j-t-E9-p3-2_F	j-t-E9-p3-2_R	j-t-E9-p3-2_P
j-t-PvARC-p-LuCnl	j-t-PvARC-p-LuCnl_F	j-t-PvARC-p-LuCnl_R	j-t-PvARC-p-LuCnl_P
j-t-StCAT_p2_p-LuPXR	j-t-StCAT_p2_p-LuPXR_F	j-t-StCAT_p2_p-LuPXR_R	j-t-StCAT_p2_p-LuPXR_P
reference (Adh1)	reference (Adh1)_F	reference (Adh1)_R	reference (Adh1)_P
c-o3Des(Pi_GA2_SNP)	c-o3Des(Pi_GA2_SNP)_F	c-o3Des(Pi_GA2_SNP)_R	c-o3Des(Pi_GA2_SNP)_P
j-t-PvARC-p3	j-t-PvARC-p3_F	j-t-PvARC-p3_R	j-t-PvARC-p3_P
j-i-Atss15_c-o3Des(Pi_GA2)	j-i-Atss15_c-o3Des(Pi_GA2)_F	j-i-Atss15_c-o3Des(Pi_GA2)_R	j-i-Atss15_c-o3Des(Pi_GA2)_P
j-p-VfSBPperm3_c-o3Des(Pir_GA)	j-p-VfSBPperm3_c-o3Des(Pir_GA)_F	j-p-VfSBPperm3_c-o3Des(Pir_GA)_R	j-p-VfSBPperm3_c-o3Des(Pir_GA)_P
c-d15Des(Ch_ERTp_GA)	c-d15Des(Ch_ERTp_GA)_F	c-d15Des(Ch_ERTp_GA)_R	c-d15Des(Ch_ERTp_GA)_P
j-i-Atss2_c-d4Des(Pl_GA)-195R)	j-i-Atss2_c-d4Des(Pl_GA)-195R)_F	j-i-Atss2_c-d4Des(Pl_GA)-195R)_R	j-i-Atss2_c-d4Des(Pl_GA)-195R)_P

Isolation of genomic flanking sequences from transgenic events

Genomic DNA sequences flanking each T-DNA insertion in events LANBCH, LBFDGG, LBFDHG, LBFGKN, LBFIHE, LBFLFK, LBFPRA, and LBFDAU were determined. Leaf samples from greenhouse grown plants were harvested and frozen. The leaf tissue was ground and genomic DNA was extracted using standard protocols for plant genomic DNA extraction. An aliquot amount of genomic DNA from each event was then used to isolate flanking sequences by adapter ligation-mediated PCR as described in O'Malley et al. 2007 Nature Protocols 2(11):2910-2917. Using this technique, PCR products were generated that contained sequence of the T-DNA border and adjacent genomic DNA. For each event distinct PCR products were obtained corresponding to the left and right border of each T-DNA locus. Individual PCR products were isolated and were sequenced using standard DNA sequencing protocols to determine sequence of the flanking regions. The flanking sequences of event LANBCH are SEQ ID NO: 212, SEQ ID NO: 213, SEQ ID NO: 214, SEQ ID NO: 215, SEQ ID NO: 216, and SEQ ID NO: 217. The flanking sequences of event LBFDGG are SEQ ID NO: 218 and SEQ ID NO: 219. The flanking sequences of event LBFDHG are SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 222, and SEQ ID NO: 223. The flanking sequences of event LBFGKN are SEQ ID NO: 224 and SEQ ID NO: 225. The flanking sequences for event LBFIHE are SEQ ID NO: 226 and SEQ ID NO: 227. The flanking sequences for event LBFLFK are SEQ ID NO: 228, SEQ ID NO: 229, SEQ ID NO: 230, and SEQ ID NO: 231. The flanking sequences for event LBFPRA are SEQ ID NO: 232, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 235, and SEQ ID NO: 236. The flanking sequences for event LBFDAU are SEQ ID NO: 237, SEQ ID NO: 238, SEQ ID NO: 239, and SEQ ID NO: 240. The flanking sequences are useful for determining the genomic location of T-DNA inserts and the integrity of the genomic DNA surrounding the insertion. For example, event LBFGKN contains a single T-DNA insertion of plasmid VC-LTM593-1qcz rc. A DNA sequence alignment of SEQ ID NO: 224 and SEQ ID NO: 3 can be used to reveal the portion of the flanking sequence that corresponds to the T-DNA right border. The portion of the flanking sequence that is not identical to the T-DNA thus corresponds to the genomic DNA that is adjacent to the T-DNA right border. Likewise, the SEQ ID NO: 225 and SEQ ID NO:3 can be aligned to identify the genomic DNA sequence that is adjacent to the T-DNA left border. For event LBFGKN, the genomic DNA fragments adjacent to the right and left border of the T-DNA can be mapped to Chromosome C04 of the *B. napus* Darmor reference genome. Based on annotation of the *B. napus* reference genome, the T-DNA of event LBFGKN is inserted more than 5000 bp away from any predicted genes or coding regions. In addition, the portions of the flanking sequences corresponding to genomic DNA indicate no rearrangements of the genomic DNA around the T-DNA insert.

Thus, in one embodiment, the plant of the invention is a transgenic plant, preferably a transgenic B. napus plant of the invention producing EPA and/or DHA, preferably EPA and DHA, comprising one or more T-DNAs for the expression of one or more genes for the production of EPA and/or DHA, whereby each T-DNA copy inserted does not disrupt any gene, e.g. no endogenous or no transgenic gene is disrupted. Preferably, the EPA and DHA content in the bulked seed is 10 mg, 15mg, 20mg, 24mg, 30mg, 31mg, 35mg, 38 mg, or more EPA and DHA / g seed. In one embodiment, the EPA and DHA content in the bulked seed is between 10mg and 70mg, between 15mg and 60mg, 20mg and 50mg, or between 24mg and 38mg.
In one embodiment the genetic insertion of the T-DNA is located >5000 base pairs away from any endogenous gene.
The plant of the invention can comprise one or more copies one T-DNA. In one embodiment, the plant is homozygous with one copy of the T-DNA integrated in each of the homozygous loci, in another embodiment, it is homozygous with two copies of the T-DNA integrated in each of the homozygous loci. Further, the plant of the invention can by heterozygous, e.g. one or two copies of the T-DNA are integrated in one herterozygous locus.

Event Specific Detection

The flanking sequences isolated from events LANBCH, LBFDGG, LBFDHG, LBFGKN, LBFIHE, LBFLFK, LBFPRA, and LBFDAU were used for the design of event specific detection assays to test for the presence T-DNA insertions. Specific primer pairs are provided in this example, but the disclosed flanking sequences could be used to design different primer pairs for producing diagnostic amplicons for each locus of each event. Endpoint Taqman qPCR assays for locus detection were developed and are described in this example. Other methods may be known and used by those skilled in the art for the detection of events LANBCH, LBFDGG, LBFDHG, LBFGKN, LBFIHE, LBFLFK, LBFPRA, and LBFDAU. Oligonucleotide primers used for the assays are listed in Table 176. Detection of each locus from LBFDAU and LBFLFK requires the use of a specific combination of forward primer, reverse primer, and probe. The TaqMan probes for targets of interest were labeled with FAM/BHQ1. The method described here is optimized for the Quantstudio™ 12K Flex Real-Time PCR system from Life Technologies, although methods can be adapted to other systems with minor modification known to those skilled in the art. Endpoint Taqman qPCR assays were carried out with JumpStart TaqReadyMix (Sigma, P2893) in a 384-well plate (Life technologies, catalogue number 4309849) in a total volume of 10 microliters per well. Per reaction, 2µl of template DNA is mixed with 8 microliters of qPCR reaction mixture. The plates were sealed with MicroAmp® Optical Adhesive Film (Life Technologies, catalogue number 4311971).

For event specific detection qPCR reaction mixture was prepared as follows:

Taqman endpoint qPCR reaction components	
PCR Component	Amount (µl) per reaction
2X Jumpstart Taq Readymix	5
25mM MgSO4	0.4
ROX (Sulforhodamine 101, 12 µM)	0.1
Forward Primer (10 µM)	0.9
Reverse Primer (10 µM)	0.9
Probe (10 µM)	0.1
gDNA (15-60ng/µl)	2
Nuclease free water	0.6
volume final	10 µl

The qPCR reactions were carried out as follows:

		Temp	Time
	step 1	95°C	5 min
45 cycles	step 2	95°C	18 sec
	step 3	60°C	1 min

Table 176: Primers and Probes used for event specific detection.

Event / Locus	Forward Primer	Reverse Primer	Probe
LANBCH locus 1 (N5)	LANBCH locus 1 (N5)_Forward primer	LANBCH locus 1 (N5)_Reverse primer	LANBCH locus 1 (N5)_Probe
LANBCH locus 1 (N9)	LANBCH locus 1 (N9)_Forward primer	LANBCH locus 1 (N9)_Reverse primer	LANBCH locus 1 (N9)_Probe

Event / Locus	Forward Primer	Reverse Primer	Probe
LANBCH locus 2 (N5)	LANBCH locus 2 (N5)_Forward primer	LANBCH locus 2 (N5)_Reverse primer	LANBCH locus 2 (N5)_Probe
LANBCH locus 2 (N9)	LANBCH locus 2 (N9)_Forward primer	LANBCH locus 2 (N9)_Reverse primer	LANBCH locus 2 (N9)_Probe
LBFDAU locus 1	LBFDAU locus 1_Forward primer	LBFDAU locus 1_Reverse primer	LBFDAU locus 1_Probe
LBFDAU locus 2	LBFDAU locus 2_Forward primer	LBFDAU locus 2_Reverse primer	LBFDAU locus 2_Probe
LBFDGG	LBFDGG_Forward primer	LBFDGG_Reverse primer	LBFDGG_Probe
LBFDHG locus 1	LBFDHG locus 1_Forward primer	LBFDHG locus 1_Reverse primer	LBFDHG locus 1_Probe
LBFDHG locus 2	LBFDHG locus 2_Forward primer	LBFDHG locus 2_Reverse primer	LBFDHG locus 2_Probe
LBFGKN	LBFGKN_Forward primer	LBFGKN_Reverse primer	LBFGKN_Probe
LBFIHE	LBFIHE_Forward primer	LBFIHE_Reverse primer	LBFIHE_Probe
LBFLFK locus 1	LBFLFK locus 1_Forward primer	LBFLFK locus 1_Reverse primer	LBFLFK locus 1_Probe
LBFLFK locus 2	LBFLFK locus 2_Forward primer	LBFLFK locus 2_Reverse primer	LBFLFK locus 2_Probe
LBFPRA Locus 1	LBFPRA Locus 1_Forward primer	LBFPRA Locus 1_Reverse primer	LBFPRA Locus 1_Probe
LBFPRA locus 2	LBFPRA locus 2_Forward primer	LBFPRA locus 2_Reverse primer	LBFPRA locus 2_Probe
LBFPRA Locus 3e	LBFPRA Locus 3e_Forward primer	LBFPRA Locus 3e_Reverse primer	LBFPRA Locus 3e_Probe

Expected amplicon sizes are given below in base pairs (plus or minus 10 bp):

Amplicon	**Amplicon Size plus or minus 10 bp**
Amplicon LANBCH locus 1 (N5)	100 bp
Amplicon LANBCH locus 1 (N9)	150 bp
Amplicon LANBCH locus 2 (N5)	150 bp
Amplicon LANBCH locus 2 (N9)	120 bp
Amplicon LBFDAU locus 1	110 bp
Amplicon LBFDAU locus 2	95 bp
Amplicon LBFDGG	100 bp
Amplicon LBFDHG locus 1	200 bp
Amplicon LBFDHG locus 2	140 bp
Amplicon LBFGKN	140 bp
Amplicon LBFIHE	110 bp
Amplicon LBFLFK locus 1	160 bp
Amplicon LBFLFK locus 2	170 bp
Amplicon LBFPRA Locus 1	570 bp
Amplicon LBFPRA locus 2	190 bp
Amplicon LBFPRA Locus 3e	90 bp

Example 25 Protein levels

Pooled seed material from four week old siliques was used for protein extraction. To enrich the membrane proteins and reduce the background signal, microsomes isolated from ground seed tissue were used to analyze protein levels for the following enzymes: c-o3Des(Pi_GA2), c-o3Des(Pir_GA), d4Des(Eg), c-d4Des(Pl_GA)2, and c-d6Elo(Tp_GA2). For c-o3Des(Pir_GA) and c-d6Elo(Tp_GA2), the microsomes were further extracted with detergent and used for ELISA. The various versions of a given gene (denoted as GA, GA2 etc.) all encoded an identical protein corresponding to the gene listed.

Initially, in a mortar cooled with liquid nitrogen, seeds were ground to a fine powder in Extraction buffer (25 mM Tris, pH 7.4; 140 mM NaCl; 3 mM KCl; 3 mM DTT; 200 mM Sorbitol; and EDTA-free Protease inhibitors (Roche)) at a ratio of 1g seed/4 ml buffer. The plant cell-debris was removed by centrifugation (5000 x g, 10 minutes, 4 °C), re-extracted by grinding a second time as described above with 1.5 ml of Extraction Buffer, and then again separated by centrifugation (5000 x g, 10 minutes, 4 °C). The supernatant from these two extractions was combined and represents the cell-free extract (typically 3.5 ml/g seed). Microsomal pellets were obtained from the cell-free extracts by ultra-centrifugation (100,000 x g, 60 minutes, 4 °C). For the c-o3Des(Pi_GA2), d4Des(Eg), c-d4Des(Pl_GA)2, enzymes the microsomal pellets were suspended in Suspension Buffer (1xTBST+1%TritonX-100). 1X TBST consists of 50 mM Tris, 150 mM NaCl, 0.05% tween 20 detergent with a final pH of 7.6 at 4 °C.

For c-o3Des(Pir_GA) and c-d6Elo(Tp_GA2) the microsomal fractions were isolated as described above, and proteins were solubilized with 1X TBST buffer and detergent of choice (For details, please see the table below). For c-d4Des(Tc_GA), c-d5Elo(Ot_GA3), c-d5Des(Tc_GA2), c-d6Des(Ot_febit), c-d6Elo(Pp_GA2), c-d12Des(Ps_GA), the seed powder was further ground in liquid nitrogen and extracted with 1xTBST+1%Triton X100+Protease Inhibitor at 1:3 W/V ratio. The supernatant was cleared at 13,000g for 20 minutes at 4°C using a micro-centrifuge and followed by a 10 minute spin at 13,000g. The clarified supernatant was used for ELISA and total protein assay.

Antibody/antigen hybridization conditions: Plates were blocked with 300 µl/well of freshly made blocking solution. The plates were sealed and incubated for 1 hour with continuous shaking. After 1 hour of incubation, the plates were washed twice with 1X TBST.

The extract from above was used in the ELISA assay. The plate was incubated with 100 µl of standards or sample extract at 4 °C for overnight, without shaking. Standards were serial diluted 1:3. The plates were sealed and incubated overnight at 4 °C. After the plates were incubated overnight, the plates were washed five times with 1X TBST. After the wash the plates were incubated with 100 µl of detecting antibody in blocking solution for 1 hour, sealed with continuous shaking. The plates were washed five times with 1X TBST at the end of the one hour incubation step. The plates were then incubated with 100 ml of HRP-conjugated donkey anti-animal of the detecting antibody secondary antibody (1:10,000) in blocking solution for 1 hour, in a sealed plate with continuous shaking. The plates were then washed five times with 1X TBST at the end of the blocking step. 100 µl of 1-step TMB was then added and the plates incubated at room temperature for 20 minutes, sealed with continuous shaking. After the twenty minutes, 100 µl of a 1M HCl solution was added and the plates read at 450 nm.

For c-d6Elo(Tp_GA2) only: all steps were the same as for the other proteins but in place of the HRP conjugated donkey anti-body system used for the others, 100 µl of biotin-conjugated donkey anti-rabbit IgG diluted 1:40,000 in 2% BSA/1X TBST was used. The plate was sealed and shaken continuously during this incubation step, which was done for one hour. The plate was washed five times with 1X TBST at the end of this step. To read this plate, the plate was incubated with 100 µl extravidin-peroxidase diluted 1:40,000 in 2% BSA/1X TBST, sealed and incubated for 1 hour with continuous shaking. The plate was then washed five times with 1X TBST. The plate was read at 450 nm.

Table 177: Overview of hybridization for protein detection and quantification. TMB (3,3',5,5'-tetramethylbenzidine) was the substrate for the horse radish peroxidase employed to visualize protein bands, supplied by Sigma-Aldrich T-0565 and used according to the instructions of the manufacturer.

	Coating AB	Blocking Buffer	Sample extraction buffer	Standard ID and dilution	Detecting AB	Secondary AB	TMB
o3Des(Pir)	AB212, 1:5,500	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 90 ng/ml, full length o3Des(Pir)	AB210 1:1,300, in blocking buffer	1:10,000 HRP-donkey anti chicken	1 step TMB, 20 min
d4Des(Tc)	AB216, 1:15,000	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 200 ng/ml, RN121	AB217, 1:15,000, in blocking buffer	1:10,000 HRP-donkey anti Rabbit	1 step TMB, 20 min
d5Elo(ot)	AB214, 1:1500,	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 200 ng/ml, RN134	AB215, 1:1500, in blocking buffer	1:10,000 HRP-donkey anti chicken	1 step TMB, 20 min
d5Des (Tc)	AB90, 1:8000	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 100 ng/ml, full lenth d5Des	AB 100, 1:40000, in blocking buffer	1:10,000 HRP-donkey anti chicken	1 step TMB, 20 min
d6Des(Ot)	AB113, 1:500	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 100 ng/ml, full length d6Des(Ot)	AB 112 rabbit, 1:10000, in blocking buffer	1:10,000 HRP-donkey anti rabbit	1 step TMB, 20 min
d6Elo(Pp)	AB 107, 1:1000	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 110 ng/ml, PA534	AB 121 chicken, 1:5000 in extraction buffer	1:10,000 HRP-donkey anti chicken	1 step TMB, 20 min
d6Elo(Tp)	AB125, 1:2000,	2% BSA in TBST	1 XTBST+1% DDM+Protease inihibitor	1:3, from 200 ng/ml, PA678	AB140, 1:1000, in blocking buffer	1:40,000 biotin-donkey anti rabbit for 1hr, then 1:40,000 extravidin-peroxidase	1 step TMB, 20 min
d12Des (Ps)	AB128, 1:3000	1% BSA in TBST	1% Triton X-100, + 1 xTBS, + Protease Inhibitor	1:3, from 200 ng/ml, PA557	AB 129, 1:3000, in blocking buffer	1:10,000 HRP-donkey anti Rabbit	1 step TMB, 20 min

Table 178: Levels of the proteins of interest were expressed as nanograms (ng) per milligram of total protein. The values were the average and standard deviation from three technical measurements of approximately four week old seed material. As one observes the construct VC-RTP10690-1qcz_F had overall less protein for the expressed genes than the combination of VC-LJB2197-1qcz and VC-LLM337-1qcz rc.

Protein	Wt	LJB2197+LLM337	VC-RTP10690-1qcz_F
c-o3Des(Pir_GA), ng/mg total microsomal protein	9.04 ± 0.5	387.5 ± 10.5	69.7 ± 1.2
c-d4Des(Tc_GA), ng/mg of total protein	0.04 ± 0.01	0.74 ± 0.03	0.1 ± 0.01
c-d5Elo(Ot_GA3), ng/mg of total protein	0.12 ± 0.01	2.85 ± 0.02	1.23 ± 0.01
c-d5Des(Tc_GA2), ng/mg of total protein	0.05 ± 0.01	2.03 ± 0.08	1.54 ± 0.03
c-d6Des(Ot_febit),ng/mg total protein	0 ± 0	4.1 ± 0.1	1.83 ± 0.01
c-d6Elo(Pp_GA2), ng/mg total protein	0 ± 0	3.77 ± 0.3	1.1 ± 0.01
c-d6Elo(Tp_GA2), ng/mg of total microsomal protein	0 ± 0	0.33 ± 0.06	0.38 ± 0.04
c-d12Des(Ps_GA), ng/mg of total protein	0.05 ± 01	1.5 ± 0.07	0.34 ± 0.03

Example 26: Desaturase and Elongase substrate specificity and selectivity observed in yeast compared with fatty acid profiles observed in canola events expressing these enzymes

As shown in Examples 10-18, the engineering of canola to convert endogenous fatty acids, such as oleic acid (18:1n-9) and LA (18:2n-6) to 20:5n-3 and 22:6n-3 requires the introduction of several desaturases and elongases. Although bioinformatics is useful for predicting the function of large, well-studied classes of enzymes, for example a delta-12 desaturase, the precise substrate tolerance of an enzyme must be determined empirically. We therefore, as shown in Examples 21 and 22, determined the substrate tolerance for each desaturase and elongase that was introduced into canola (Examples 10-18). Understanding the substrate profile for each of the introduced enzymes allowed optimal engineering of canola to produce EPA and DHA by:

(1) Conversion of the three most predominant canola endogenous fatty acids (OA, LA, and ALA, see Kumily profiles in Examples 10-18) to EPA and DHA,
(2) Minimizing generation of side reactions, and
(3) Providing a proof-reading mechanism that re-routes side-products back into the biosynthesis of EPA and DHA.

Examples provided herein further detail how the deduced specificity of the introduced desaturases and elongases allowed optimal engineering of canola to produce oil enriched in EPA and DHA.

Delta-6-desaturase:

Yeast feeding studies (Table 159 and Table 163) show that the delta-6-desaturase (*Ostreococcus tauri*) can readily accept substrates containing, LA (18:2n-6) and ALA (18:3n-3). As shown in

Tables 148-152, the resulting GLA (18:3n-6) delta-6-desaturase (*Ostreococcus* tauri) product can be processed by either of the delta-6-elongases (*Physcomitrella patens* or *Thalassiosira pseudonana*), followed by the delta-5-desaturase (*Thraustochytrium* sp. ATCC21685), either of the omega-3-desaturases (*Phythophthora infestans* or *Pythium irregulare*), the delta-5-elongase (*Ostreococcus tauri*) and finally either of the delta-4-desaturases (*Thraustochytrium* sp.and *Pavlova lutheri*) to yield DHA (22:6n-3). The resulting ALA desaturation product, SDA (18:4n-3), can be converted by either of the delta-6-elongases (*Physcomitrella patens* or *Thalassiosira pseudonana*) to a 20:4n-3 containing fatty acid (see Table 160), which can be accepted by the delta-5-desaturase (*Thraustochytrium* sp. ATCC21685) to generate an EPA (20:5n-3) linked fatty acid as shown in Table 162.The fatty acid analysis data presented for the engineered canola lines in Examples (10-18) show significantly lower levels of ALA relative to non-transgenic Kumily controls, consistent with the engineered conversion of ALA to 20:5n-3 and 22:6n-3.

Delta-6-elongases:

Yeast feeding studies (Table 160 and Table 163) show that both of the delta-6-elongases, *Physcomitrella patens* and *Thalassiosira pseudonana*, accept 18-carbon chain substrates but prefer molecules desaturated at carbon-6 (see GLA (18:3n-6) and SDA (18:4n-3) vs. LA (18:2n-6) and ALA (18:3n-3). The delta-6-elongase from *Thalassiosira pseudonana* is much more stringent than the one from *Physcomitrella patens* in recognizing the delta-6-desaturated fatty acids. In the fatty acid analysis of the engineered canola lines presented in Examples (10-18) 20:2n-6 and 20:3n-3, resulting from desaturation of LA and ALA respectively, are detected. The inclusion of these specific elongases from *Physcomitrella patens* and *Thalassiosira pseudonana* allowed preferred conversion of fatty acids desaturated at carbon-6 thus, providing maximum conversion of of EPA and DHA from GLA and SDA. Fatty acid profiles of the LTM593 (Example 18) line show levels of 20:2n-6 and 20:3n-3 that are about the same as found in wild-type Kumily confirming the specificity of the delta-6 elongases from *Physcomitrella patens* and *Thalassiosira pseudonana* upon introduction into canola.

Delta-5-desaturase:

Yeast feeding studies (Table 159 and Table 162 and Table 163) show that the delta-5-desaturase (*Thraustochytrium* sp. ATCC21685) accepts DHGLA (20:3n-6) and 20:4n-3. As described above (Example 26 (this section), Delta-6-desaturase), the ability of the delta-5-desaturase (*Thraustochytrium* sp. ATCC21685) to desaturate 20:4n-3 is important for the conversion of ALA and SDA into 20:5n-3 and 22:6n-3.

Omega-3-desaturases:

Yeast feeding studies show that both omega-3-desaturases, (*Phythophthora infestans* and *Pythium irregulare*) can accept ARA (20:4n-6), DTA (22:4n-6), and DHGLA (20:3n-6). These omega-3-desaturases prefer molecules with 4 double bonds. In the transgenic canola lines described in Examples (10-18), the ability of these omega-3-desaturases to utilize 22:4n-6 as a substrate, as shown in Table 163, allows re-direction of ARA (20:4n-6) that has been elongated by the delta-5-elongase (*Ostreococcus tauri*) back into the pathway as 22:5n-3 (a substrate for the engineered delta-4 desaturases) for synthesis of DHA (22:6n-3). Fatty acid profiles of the

LTM593 (Example 18) line show detectable, but low levels of 22:4n-6 consistent with this fatty acid being converted to 22:5n-3 *in vivo* the described canola that was engineered to synthesize DHA.

Delta-5-elongase:

Yeast feeding studies show (Table 161 and Table 163) that the delta-5-elongase (*Ostreococcus tauri*) prefers 20-carbon chain substrates, EPA (20:5n-3) and ARA (20:4n-6), but can also extend lipids containing 18-carbon chains, like SDA (18:4n-3) and ALA (18:3n-3). In the engineered canola (Examples 10-18) the presence of the omega-3-desaturases, (*Phythophthora infestans* and *Pythium irregulare*), allows the 22:4n-6 product, resulting from the elongation of ARA, to be converted to 22:5n-3 and which is then desaturated by the delta-4-desaturases (*Thraustochytrium* sp.and *Pavlova lutheri*) to produce the final product, 22:6n-3. Fatty acid analysis of the transgenic canola lines described in Examples 10-18 shows minor levels of 22:4n-6, likely due to the ability of the omega-3 desaturases to redirect this lipid back into the biosynthesis of 22:6n-6. The 20:4n-3 produced from the extension of SDA is a substrate recognized by the delta-5-desaturase (*Thraustochytrium* sp. ATCC21685) and can be converted to 20:5n-3, the preferred substrate of the delta-5-elongase (*Ostreococcus tauri*).

Delta-4-desaturases:

Yeast feeding studies (Table 159 and Table 163) show that both delta-4-desaturases, (*Thraustochytrium* sp.and *Pavlova lutheri*) can accept 22:5n-3 and DTA (22:4n-6) with a slight preference for 22:5n-3.

Example 27: Using differentially labeled heavy peptides to monitor digestion efficiency in quantitative LC-MS.

The described method provides an avenue for quantitating digestion efficiency in targeted proteomics experiments. In most MRM LC-MS applications, measuring digestion efficiency relies on an indirect measurement which examines a peptide profile of the sample by comparing the number of missed cleavage peptides detected to the number of completely digested peptides detected in a separate LC-MS experiment. While providing an overall perspective of the trypsin efficiency within the experiment, the data does little to address specific digestion of the target sequence being monitored in the MRM experiment. Measuring global digestion efficiency does not address possible sequence specific biases in trypsin activity and may result in misrepresentation of target quantity. Indeed, there was a growing appreciation that trypsin digestion kinetics was strongly influenced by sequence context (Proc J. et al. 2010. Journal of Proteome Res. 9:5422-5437, and Lowenthal M. et al. 2014. Anal Chem. 86:551-558). In order to measure sequence specific digestion efficiency we use two differentially-labeled heavy peptides to obtain a ratio for digestion efficiency (scheme 1). Peptide three includes the correct sequence context for the target by including four amino acids both amino and carboxyl to the two trypsin cleavage sites that generate the native peptide. In general, three amino acids were considered sufficient for trypsin to identify its cleavage site (Makriyannis T. and Y. Clonis. 1997. Biotech Bioeng. 53:49-57) and hydrolysis rates were only affected by the closest two amino acids (Lowenthal M. et al. 2014. Anal Chem. 86:551-558). This scheme allows us to simultaneously assess specific digestion efficiency and also obtain quantitation data for the target molecule. In this design, the two peptides were spiked at equimolar concentrations into the test sample prior to digestion. During sample analysis, transitions were monitored for the target peptide and the two heavy peptide products. Peak intensities obtained from the two heavy peptides were compared to get a ratio for digestion efficiency and the target peptide intensities were used for quantitation.

Scheme 1

Example protein: O3D (Pir)

Sequence:
MASTSAAQDAAPYEFPSLTEIKRALPSECFEASVPLSLYYTARSLALAGSLAVALSYARALPLVQ
ANALLDATLCTGYVLLQGIVFWGFFTVGHDCGHGAFSRSHVLNFSVGTLMHSIILTPFESWKLS
HRHHHKNTGNIDKDEIFYPQREADSHPVSRHLVMSLGSAWFAYLFAGFPPRTMNHFNPWEAM
YVRRVAAVIISLGVLFAFAGLYSYLTFVLGFTTMAIYYFGPLFIFATMLVVTTFLHHNDEETPWYA
DSEWTYVKGNLSSVDRSYGALIDNLSHNIGTHQIHHLFPIIPHYKLNDATAAFAKAFPELVRKNA
APIIPTFFRMAAMYAKYGVVDTDAKTFTLKEAKAAAKTKSS
target peptide (underlined), native sequence contained in synthetic peptide for digestion efficiency (redouble underlined)

Peptides
DEIFYPQR (native peptide measured from sample)
DEIFYPQ(15N13CR) (for standard curve, and normalization)
NIDKDEIFY(15N13CP)Q(15N13CR)EADS (for digestion efficiency)

Standard peptides (2) (3) were spiked into the test sample at the same concentration prior to proteolysis. After proteolysis the transitions for the product peptides, (2) and DEIFY(15N13CP)Q(15N13CR) were compared in product ion intensity in order to determine the digestion efficiency of the targeted sequence within the context of its native sequence according to the following equation:

$$\%\, digestion\ efficiency = \frac{\text{peak intensity DEIFY(15N13CP)Q(15N13CR)}}{\text{peak intensity DEIFYPQ(15N13CR)}} * 100$$

The % digestion efficiency is therefore measured in the test sample directly and can be used to assess the impact on detected target concentration.

Example 28: Use of different germplasm to optimize production of VLC-PUFA

It appears that expression of the same or very similar gene sets in different host plants, such as *Camelina sativa* (Ruiz-Lopez et al., 2014), results in a larger yield of VLC-PUFA than has been attainable in *Brassica napus*. This notion is illustrated by the data in Table 179. Table 179 contains fatty acid data from seeds of transgenic *B. napus* (LBJ1671) and transgenic *C. sativa* (RRes_EPA_line) transformed with nearly identical T-DNAs and the respective wild type controls. The only difference between the constructs used to make the two transgenic lines is that the

TDNA used to make the transgenic *B. napus* (LBJ1671) has an extra GFP expression cassette adjacent to the right border. When comparing transgenic *B. napus* (LJB1671) to the WT Kumily control, there is a decrease in the amount of 18:1 and increases in the amounts of 18:2 and 18:3 fatty acids. The 18:2 and 18:3 fatty acids are intermediates of the pathway introduced by LJB1671, and therefore the elongation of 18:2 and 18:3 fatty acids into 20C fatty acids can be considered a bottleneck reaction in *B. napus.* On the other hand, when comparing transgenic *C. sativa* (RRes_EPA_line) to the WT control, there is a decrease in 18:1 and also in 18:2 and 18:3 fatty acids. Therefore, the elongation of 18:2 and 18:3 fatty acids is not a bottleneck in *C. sativa*. The absence of this bottleneck in *C. sativa* results in 10-fold higher 20:5n-3 (EPA) content compared to the transgenic *B. napus*.

The conversion of 18:1 to 18:2 and of 18:2 to 18:3 occurs largely in the phospholipid membrane, while the elongation of 18C fatty acids to 20C fatty acids occurs strictly in the acyl-CoA pool. This difference in substrate specificity means that 18C fatty acids must be released from membrane phospholipids in order to be elongated. This release is apparently a bottleneck in *B. napus*, but not in *C. sativa*. The difference in flux of 18:2 from PC into the CoA pool between these two species could be due to differences in the activities of numerous enzymes, including: 1) phospholipases, 2) acyl-CoA synthetases, 3) lyso-PC acyltransferases, 4) phospholipid-diacylglycerol choline transferases, 5) phospholipid-diacylglycerol acyl transferases, and others. As a consequence of these observations, transforming any of the constructs from example 11 to example 18 into variety of species and germplasms (such as other Brassica germplasms in the so called Triangle of U), would result in a prefered embodiement of the present invention (e.g. higher amounts of EPA and DHA, and/or lower amounts of 18:2n-6).

Table 179: Introduction of a construct that was isogenic for all genes involved in VLC-PUFA synthesis into ***Brassica napus*** cv Kumily and into ***Camelina sativa***.Average fatty acid data of segregating T1 seed of 26 events containing the T-DNA of LJB1671 and wild type (WT) ***Brassica napus*** cv Kumily are shown in the top two rows of data. For line RRes_EPA, fatty acid profiles of T3 homozygous seeds of selected insertion events, and of the respective WT control, are shown. RRes_EPA line and WT ***Camelina sativa*** data were taken from supplemental table S1 of Ruiz-Lopez ***et al.***, 2014. n.d, not determined.

Event	**Other**	**16:0**	**16:1 n-7**	**16:3 n-3**	**18:0**	**18:1 n-9**	**18:2 n-6**	**18:2 n-9**	**18:3 n-3**	**18:3 n-6**	**18:4 n-3**	**20:0**	**20:1 n-9**	**20:2 n-6**	**20:3 n-3**	**20:3 n-6**	**20:4 n-3**	**20:4 n-6**	**20:5 n-3**	**22:0**	**22:1 n-9**
LJB1671 introduced into Kumily (n=26)	0	5 ± 0.5	0.2 ± 0.1	0.1 ± 0.1	2.6 ± 0.6	37.8 ± 10.9	29.1 ± 4.3	0.4 ± 0.4	7.8 ± 1.2	4.4 ± 5.4	2 ± 2.7	0.9 ± 0.2	1.3 ± 0.4	1.8 ± 1.8	0.6 ± 0.6	1.5 ± 1	1 ± 0.7	0.8 ± 0.5	2.1 ± 1.5	0.5 ± 0.1	0 ± 0
WT Kumily greenhouse (n=46)	0	5 ± 0.1	0.4 ± 0	0.2 ± 0	2.6 ± 0.1	66.3 ± 1.7	16.8 ± 1.3	0 ± 0	6.1 ± 0.4	0	0	0.9 ± 0	1.2 ± 0	0	0	0	0	0	0	0.5 ± 0	0 ± 0
RRes_EPA line	11.9 ± 1.0	8.3 ± 0.6	n.d	n.d	6.7 ± 0.9	5.0 ± 0.8	20.6 ± 1.2	n.d	15.8 ± 2.9	2.4 ± 1.7	1.5 ± 1.2	n.d	7.0 ± 0.9	n.d	n.d	1.1 ± 0.4	3.2 ± 1.1	1.6 ± 0.3	14.7 ± 2.8	n.d	n.d
WT *Camelina sativa*	11.2 ± 0.1	6.5 ± 0.1	n.d	n.d	3.4 ± 0.1	14.5 ± 0.4	19.0 ± 0.6	n.d	30.8 ± 0.6	0	0	n.d	14.5 ± 0.1	n.d	n.d	0	0	0	0	n.d	n.d

Example 29: Fatty acid analysis of canola oils and commercial oil and solid samples (Total FAME analysis)

Canola seeds:

10-15 canola seeds were transferred into tubes on a 96-format rack and closed with cap strips. Seeds were ground in a swing mill using 3 mm beads for 2 x 2 min at 30 Hz. The rack was then centrifuged for 5 min at 4000 rpm to remove powder from the lid. Extraction of oil was carried out by adding 800 µL of methyl *tert*-butyl ether (MTBE) to the samples followed by extraction in a swing mill for 2 x 30 sec at 30 Hz. After centrifugation at 4000 rpm for 10 min, 40 µL of the clear supernatant was transferred into a 96-well micro rack and diluted using 260 µL MTBE. Lipids were derivatized into fatty acid methyl esters (FAMEs) by adding 20 µL trimethylsulfonium hydroxide solution (TMSH, 0.2 M in methanol) into each sample. The rack was closed using silicone/PTFE cap mats and incubated for 20 min at room temperature.

Arabidopsis seeds:

20 mg of seeds were transferred into tubes on a 96-format rack. The canola seed protocol was followed in all further steps.

Canola oils and commercial oil samples:

20 µL of oil was transferred into a glass vial and diluted using 1 mL MTBE. 20-80 µL of the sample-solutions were transferred into into a 96-well micro rack and diluted using 260 µL MTBE. Lipids were derivatized into FAMEs by adding 20 µL trimethylsulfonium hydroxide solution (TMSH, 0.2 M in methanol) into each sample. The rack was closed using silicone/PTFE cap mats and incubated for 20 min at room temperature.

Commercial solid samples:

Solid samples were lyophilized prior to analysis. 20 mg of solid samples were transferred into tubes on a 96-format rack. The canola seed protocol was followed in all further steps.

An overview on the samples is provided in the following Table.

Table 180: Samples description

Sample Name	Description	Source/Origin
Transgenic plant samples (T-DNA identity)		
LANBCH oil	*B. napus* (VC-LJB2197-1qcz, VC-LLM337-1qcz rc)	2014 Field season
LANPMZ seeds	*B. napus* (VC-LJB2197-1qcz, VC-LLM337-1qcz rc)	2012 Field season
LAODDN seeds	*B. napus* (VC-LJB2755-2qcz rc, VC-LLM391-2qcz rc)	2012 Field season
LBFDAU oil	*B. napus* (VC-LTM593-1qcz rc)	2014 Field season
LBFGKN seeds	*B. napus* (VC-LTM593-1qcz rc)	2014 Field season
LBFGKN oil	*B. napus* (VC-LTM593-1qcz rc)	2014 Field season
LBFLFK seeds	*B. napus* (VC-LTM593-1qcz rc)	2014 Field season
LBFLFK oil	*B. napus* (VC-LTM593-1qcz rc)	2014 Field season
Arabidopsis seeds	*A. thaliana* (VC-LTM593-1qcz rc)	Greenhouse
Non-transgenic plant samples		

Kumily seeds	wild type *B. napus*	2012 Field season
Kumily oil	wild type *B. napus*	2012 Field season
Canola Commodity oil	canola oil blend	
Clear Valley 65 oil	canola oil blend (65% oleic acid)	
Clear Valley 80 oil	canola oil blend (80% oleic acid)	
Brassica juncea seeds	wild type *B. juncea* (high erucic acid variety)	
Borage oil	oil preparation from plants (*Borago officinalis*)	
Echium oil	oil preparation from plants (*Echium plantagineum*)	
Primrose oil	oil preparation from plants (*Oenothera*)	
Land animal fat samples		
Beef (corned beef)	prepared beef product	
Butter 1	butter from cow milk	
Butter 2	butter from cow milk	
Egg yolk from chicken	egg yolk powder from chicken	
Fish/Crustacean oil samples		
Menhaden oil	oil preparation from fish (Menhaden)	
Salmon oil capsule	oil preparation from fish (Salmon)	
Tuna 1 oil	oil preparation from fish (Tuna)	
Anchovy 2 oil	oil preparation from fish (Anchovy)	
Krill oil capsule	oil preparation from crustacean (Krill)	
Algal oil samples		
DHA DHA oil capsule	oil preparation from algae	
Omega EPA/DHA oil capsule	oil preparation from algae	
Omega-3 EPA & DHA	oil preparation from algae	
Omega 3 algae oil	oil preparation from algae	
Fungal oil sample		
Mortierella alpina ARA-rich oil	oil preparation from fungi	

GC analysis:

An Agilent 7890A gas chromatograph coupled to Agilent flame ionization detector was used for FAME analysis. Separation of FAMEs was carried out on a DB-225 capillary column (20 m x 180 µm x 0.2 µm, Agilent) using H_2 as carrier gas with a flow rate of 0.8mL/min. The GC was operated in split mode using a split ratio of 1:50 at an injector temperature of 250 °C, injection volume was 1 µL. Oven temperature was held at 190 °C for 3 min and increased to 220 °C with 15 °C min^{-1}. Temperature was held at 220 °C for another 6 min. Peak detection and integration was carried out using Agilent GC ChemStation software (Rev. B.04.02 SP1).

Table 181: Fatty acids determined by FAME analysis

Shorthand Name	Trivial Name	Fatty Acid Name (systematic name)	Fatty Acid Souce
14:0	Myristic acid	Tetradecanoic acid	Supelco 37 Component FAME Mix
16:0	Palmitic acid	Hexadecanoic acid	Supelco 37 Component FAME Mix

16:1n-9		(Z)-7-Hexadecenoic acid	single standard
16:1n-7	Palmitoleic acid	(Z)-9-Hexadecenoic acid	Supelco 37 Component FAME Mix
17:0	Margaric acid	Heptadecanoic Acid	Supelco 37 Component FAME Mix
16:3n-3		(Z,Z,Z)-7,10,13-Hexadecatrienoic acid	single standard
18:0	Stearic acid	Octadecanoic acid	Supelco 37 Component FAME Mix
18:1n-9	Oleic acid	(Z)-9-Octadecenoic acid	Supelco 37 Component FAME Mix
18:1n-7	Vaccenic acid	(Z)-11-Octadecenoic acid	single standard
18:2n-9		(Z,Z)-6,9-Octadecadienoic acid	single standard
18:2n-6	Linoleic acid	(Z,Z)-9,12-Octadecadienoic acid	Supelco 37 Component FAME Mix
18:3n-6	gamma-Linolenic acid	(Z,Z,Z)-6,9,12-Octadecatrienoic acid	Supelco 37 Component FAME Mix
18:3n-3	alpha-Linolenic acid	(Z,Z,Z)-9,12,15-Octadecatrienoic acid	Supelco 37 Component FAME Mix
18:4n-3	Stearidonic acid	(Z,Z,Z,Z)-6,9,12,15-Octadecatetraenoic acid	single standard
20:0	Arachidic acid	Eicosanoic acid	Supelco 37 Component FAME Mix
20:1n-9	Gondoic acid	(Z)-11-Eicosenoic acid	Supelco 37 Component FAME Mix
20:2n-9		(Z,Z)-8,11-Eicosadienoic acid	no standard
20:3n-9	Mead acid	(Z,Z,Z)-5,8,11-Eicosatrienoic acid	single standard
20:2n-6		(Z,Z)-11,14-Eicosadienoic acid	Supelco 37 Component FAME Mix

20:3n-6	Dihomo-gamma-linolenic acid	(Z,Z,Z)-8,11,14-Eicosatrienoic acid	Supelco 37 Component FAME Mix
20:4n-6	Arachidonic acid	(Z,Z,Z,Z)-5,8,11,14-Eicosatetraenoic acid	Supelco 37 Component FAME Mix
20:3n-3		(Z,Z,Z)-11,14,17-Eicosatrienoic acid	Supelco 37 Component FAME Mix
20:4n-3		(Z,Z,Z,Z)-8,11,14,17-Eicosatetraenoic acid	single standard
20:5n-3	Timnodonic acid	(Z,Z,Z,Z,Z)-5,8,11,14,17-Eicosapentaenoic acid	Supelco 37 Component FAME Mix
22:0	Behenic acid	Docosanoic acid	Supelco 37 Component FAME Mix
22:1n-9	Erucic acid	(Z)-13-Docosenoic acid	Supelco 37 Component FAME Mix
22:2n-6		(Z,Z)-13,16-Docosadienoic acid	Supelco 37 Component FAME Mix
22:4n-6	Adrenic acid	(Z,Z,Z,Z)-7,10,13,16-Docosatetraenoic acid	single standard
22:5n-6	Osbond acid	(Z,Z,Z,Z,Z)-4,7,10,13,16-Docosapentaenoic acid	single standard
22:4n-3		(Z,Z,Z,Z)-10,13,16,19-Docosatetraenoic acid	no standard
22:5n-3	Clupanodonic acid	(Z,Z,Z,Z,Z)-7,10,13,16,19-Docosapentaenoic acid	single standard
22:6n-3		(Z,Z,Z,Z,Z,Z)-4,7,10,13,16,19-Docosahexaenoic acid	Supelco 37 Component FAME Mix
24:0	Lignoceric acid	Tetracosanoic Acid	Supelco 37 Component FAME Mix
24:1n-9	Nervonic acid	Tetracosenoic Acid	Supelco 37 Component FAME Mix

The commercially available Supelco® 37 Component FAME Mix was used to identify retention times of 22 from 34 target fatty acids, 10 further fatty acids were spiked into the mix or analyzed separately to obtain retention times. For two of the target FAs, no commercial standard was available.

Peak areas of the detected target fatty acids were added up to yield the total peak area. The fatty acid profile and percentage of individual fatty acids was then calculated as peak area percent of total peak area.

The results are shown in the table 182. In all cases, oil data are data from bulk seed collected from field grown plants, rather than from single seed from a greenhouse environment.

20:3 n-6 (DHGLA) ranges from 1.6-3.1% in our transgenic canola samples. However, other EPA DHA containing samples, such as transgenic Arabidopsis seeds, fish oil, and algal oil (with more than 1% combined EPA and DHA), do not contain more than 1.1% DHGLA. DHGLA is the product of a delta-6-elongase acting on GLA.

20:3 n-9 (Mead acid) ranges from 0.05-0.23% in our transgenic canola. We also observe 20:3 n-9 in transgenic Arabidopsis and in egg yolk. However, other EPA DHA containing samples, such as fish oil and algal oil (with more than 1% combined EPA and DHA), do not contain mead acid. Therefore, the accumulation of mead acid does not always accompany EPA DHA production. The production of mead acid is the result of delta-6-desaturase activity on 18:1 n-9, followed by the activities of the delta-6-elongase and delta-5-desaturase, and it is the combined properties of our enzymes that result in the production of mead acid.

22:5 n-3 (DPA) ranges from 1.9-4.1% in the transgenic canola samples. The amount of DPA does reach 3.3% in one of the algal oil samples, but transgenic Arabidopsis only accumulates 0.1% DPA. DPA accumulation is typically below 2% in transgenic camelina and canola engineered to produce EPA and DHA (Petrie et al. 2014 PLoS One 9(1) e85061, and WO 2015/089587). DPA accumulation above 2% is only achieved when the delta-4-desaturase has been inactivated (and no DHA is produced) in transgenic brassica napus. In the events examined in this example, there are two copies of the delta-4-desaturase, and we produce DHA, so it is surprising that DPA accumulates.

The total amount of saturated fatty acids in our transgenic canola is low. 16:0 ranges from 4.4 to 5.2% and 18:0 ranges from 2.5 to 2.7%.

18:4 n-3 (SDA) ranges from 0.1 to 0.4% in the transgenic canola samples. This level of SDA is surprisingly low since our delta-6-desaturase has slightly higher activity with ALA than with LA (Table 163).

There are a variety of VLC-PUFA that occur in the transgenic events that do not occur in WT Kumily plants. These fatty acids include 18:2n-9, GLA, SDA, 20:2n-9, 20:3n-9, 20:3 n-6, 20:4n-

6, 22:2n-6, 22:5n-6, 22:4n-3, 22:5n-3, and 22:6n-3. The combined amount of these fatty acids ranged from 15.1% to 24.8% in transgenic canola samples.

Table 182 (Part A): Fatty acid profile of 34 target fatty acids from total lipids after MTBE extraction, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area.

Sample name	14:0	16:0	16:1n-9	16:1n-7	17:0	16:3n-3	18:0	18:1n-9	18:1n-7	18:2n-9	18:2n-6 (LA)	18:3n-6 (GLA)	18:3n-3 (ALA)	18:4n-3 (SDA)	20:0	20:1n-9
LANBCH oil	0,1	4,6	0,0	0,2	0,1	0,1	2,7	26,3	3,1	0,7	31,7	1,3	5,7	0,3	0,6	0,8
LANPMZ seeds	0,1	4,9	0,0	0,2	0,1	0,1	2,7	29,1	2,9	0,5	33,6	0,8	4,3	0,1	0,8	0,9
LAODDN seeds	0,1	5,2	0,0	0,2	0,1	0,2	2,5	28,2	3,2	0,6	35,1	1,4	5,6	0,4	0,8	0,7
LBFDAU oil	0,1	4,6	0,0	0,2	0,0	0,1	2,7	26,9	3,1	1,0	29,5	1,6	5,8	0,3	0,6	0,7
LBFGKN seeds	0,1	4,5	0,0	0,2	0,1	0,1	2,5	30,9	3,7	0,5	33,2	0,9	6,8	0,2	0,6	0,8
LBFGKN oil	0,1	4,4	0,0	0,2	0,0	0,1	2,6	32,2	2,9	0,5	33,2	0,9	6,8	0,2	0,6	0,8
LBFLFK seeds	0,1	4,8	0,0	0,2	0,1	0,1	2,7	26,4	3,9	0,9	30,3	1,6	5,7	0,3	0,6	0,8
LBFLFK oil	0,1	4,6	0,0	0,2	0,1	0,1	2,7	27,9	3,0	0,9	30,6	1,5	5,8	0,3	0,6	0,8
Arabidopsis seeds	0,1	7,0	0,0	0,2	0,1	0,1	5,3	8,9	1,8	0,2	22,3	0,3	16,8	0,1	3,5	17,5
Kumily seeds	0,1	4,7	0,0	0,3	0,1	0,1	1,9	57,1	3,8	0,0	20,1	0,0	9,3	0,0	0,6	1,1
Bovine fat (corned beef)	3,7	24,6	0,3	3,7	1,2	0,0	16,9	43,9	1,9	0,5	1,6	0,2	0,7	0,1	0,1	0,2
Butter 1	14,2	37,7	0,3	1,9	0,7	0,0	12,7	26,8	1,4	0,8	2,0	0,0	0,6	0,0	0,2	0,1
Butter 2	13,4	37,4	0,3	2,0	0,7	0,0	12,3	27,5	1,6	0,8	2,4	0,0	0,5	0,0	0,2	0,1
Egg yolk from chicken	0,5	25,0	0,6	2,2	0,3	0,0	8,7	35,7	1,5	0,1	19,1	0,3	0,8	0,2	0,1	0,3
Menhaden oil	8,9	17,1	0,2	12,6	2,3	0,1	3,0	7,2	3,4	0,1	1,8	0,4	1,5	3,4	0,3	1,1
Salmon oil capsule	7,8	17,0	0,3	8,6	1,7	0,1	3,5	9,4	3,4	0,2	1,9	0,4	1,1	2,8	0,6	1,9
Tuna 1 0525 oil	3,9	19,7	0,4	5,0	1,3	0,0	5,1	14,9	2,5	0,1	2,0	0,3	0,5	1,0	0,4	1,5
Omevital Anchovy oil	7,3	18,0	0,3	8,6	1,8	0,1	3,9	9,6	3,2	0,2	1,8	0,5	0,9	3,3	0,6	1,6
Krill oil capsule	12,7	21,3	0,1	6,8	0,3	0,1	1,2	10,9	7,0	0,2	2,3	0,3	1,3	4,2	0,1	0,7
DHA DHA oil capsule	5,8	16,0	0,0	0,3	0,1	0,2	1,0	15,4	0,3	0,0	1,3	0,3	0,1	0,3	0,1	0,1
Omega EPA/DHA oil capsule	1,3	16,1	0,0	0,2	0,1	0,0	1,9	26,0	0,2	0,0	2,2	0,1	0,2	0,2	0,4	0,1

Omega-3 EPA & DHA	1,9	19,2	0,0	0,3	0,5	0,0	1,7	10,2	0,2	0,0	1,4	0,1	0,1	0,2	0,4	0,1
Omega 3 algae oil	5,4	15,4	0,0	0,3	0,1	0,2	1,0	15,0	0,2	0,0	1,5	0,3	0,1	0,4	0,1	0,1
Mortierella alpina ARA-rich oil	0,4	6,1	0,0	0,1	0,2	0,0	6,2	5,6	0,3	0,0	7,9	2,3	0,1	0,0	0,9	0,3

Table 182 (Part B): Fatty acid profile of 34 target fatty acids from total lipids after MTBE extraction, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area.

Sample name	20:2n-9	20:3n-9	20:2n-6	20:3n-6 (DHGLA)	20:4n-6 (ARA)	20:3n-3	20:4n-3 (ETA)	20:5n-3 (EPA)	22:0	22:1n-9	22:2n-6	22:4n-6	22:5n-6	22:4n-3	22:5n-3 (DPA)	22:6n-3 (DHA)	24:0	24:1
LANBCH oil	0,2	0,1	0,3	1,6	3,4	0,1	1,0	7,5	0,3	0,0	0,1	1,5	0,0	0,4	4,1	1,3	0,1	0,1
LANPMZ seeds	0,6	0,2	0,6	2,1	3,3	0,2	1,0	5,6	0,4	0,0	0,1	1,3	0,0	0,4	2,5	1,0	0,2	0,2
LAODDN seeds	0,1	0,1	0,1	1,5	1,2	0,1	1,0	6,0	0,4	0,0	0,0	1,1	0,0	0,5	2,7	0,9	0,2	0,2
LBFDAU oil	0,3	0,1	0,1	2,9	2,2	0,1	1,9	10,1	0,3	0,0	0,0	0,4	0,1	0,2	2,6	1,4	0,1	0,1
LBFGKN seeds	0,2	0,1	0,2	1,8	2,0	0,1	1,1	5,7	0,3	0,0	0,0	0,4	0,0	0,2	2,0	0,9	0,1	0,2
LBFGKN oil	0,2	0,1	0,2	1,7	1,9	0,1	1,0	5,5	0,3	0,0	0,0	0,4	0,0	0,1	1,9	0,9	0,1	0,1
LBFLFK seeds	0,2	0,1	0,1	2,8	2,2	0,1	1,6	8,4	0,3	0,0	0,0	0,7	0,1	0,4	3,3	1,3	0,1	0,2
LBFLFK oil	0,2	0,1	0,1	3,1	2,1	0,1	1,8	7,9	0,3	0,0	0,0	0,6	0,1	0,4	3,0	1,2	0,1	0,1
Arabidopsis seeds	0,6	0,6	1,4	0,3	0,5	1,7	0,5	5,6	0,5	2,0	0,0	0,7	0,0	0,0	0,1	1,3	0,2	0,4
Kumily seeds	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,1	0,2
Bovine fat (corned beef)	0,0	0,0	0,0	0,1	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,0
Butter 1	0,0	0,0	0,0	0,1	0,2	0,0	0,0	0,1	0,1	0,0	0,0	0,2	0,0	0,0	0,1	0,0	0,0	0,0
Butter 2	0,0	0,0	0,0	0,1	0,2	0,0	0,0	0,1	0,1	0,0	0,0	0,1	0,0	0,0	0,1	0,0	0,0	0,0
Egg yolk from chicken	0,0	0,1	0,2	0,2	1,9	0,0	0,0	0,4	0,0	0,0	0,0	0,1	0,4	0,0	0,1	1,3	0,0	0,0
Menhaden oil	0,2	0,0	0,3	0,3	1,3	0,3	1,7	16,4	0,2	0,2	0,0	0,3	0,6	0,1	2,8	12,1	0,2	0,3
Salmon oil capsule	0,2	0,0	0,2	0,2	1,6	0,1	1,0	19,5	0,2	0,3	0,0	0,2	0,4	0,1	2,5	12,7	0,1	0,6

Tuna 1 oil	0,0	0,0	0,3	0,2	2,2	0,2	0,5	7,5	0,2	0,2	0,0	0,3	1,8	0,1	1,3	26,6	0,2	0,6
Anchovy 2 oil	0,2	0,0	0,2	0,2	1,4	0,1	1,0	19,5	0,2	0,3	0,0	0,2	0,4	0,1	2,1	12,7	0,1	0,5
Krill oil capsule	0,0	0,0	0,1	0,2	0,8	0,1	0,5	18,4	0,1	0,5	0,0	0,0	0,2	0,0	0,4	9,2	0,1	0,1
DHA DHA oil capsule	0,0	0,0	0,0	0,8	0,7	0,1	0,8	1,1	0,2	0,0	0,0	0,1	15,6	0,1	0,4	38,6	0,5	0,0
Omega EPA/DHA oil capsule	0,0	0,0	0,0	0,2	1,4	0,1	0,6	17,0	0,3	0,0	0,0	0,2	1,2	0,0	3,1	26,8	0,2	0,0
Omega-3 EPA & DHA	0,0	0,0	0,0	0,3	1,8	0,1	0,8	19,5	0,2	0,1	0,0	0,3	1,9	0,0	3,3	35,6	0,1	0,0
Omega 3 algae oil	0,0	0,0	0,0	1,1	1,0	0,1	0,9	1,3	0,3	0,0	0,0	0,1	16,0	0,1	0,6	38,2	0,5	0,0
Mortierella alpina ARA-rich oil	0,0	0,0	0,4	4,4	48,5	0,5	0,0	0,2	3,4	0,1	0,0	0,5	0,0	0,2	0,0	0,1	11,2	0,4

Example 30: Lipid Profiling of canola oils and commercial oil samples:

Canola seeds:

12-15 canola seeds were transferred into micro tubes on a 96-format rack and closed with cap strips. Seeds were ground in a swing mill using 3 mm beads for 2 x 2 min at 30 Hz. The rack was then centrifuged for 5 min at 4000 rpm to remove powder from the lid. Extraction of oil was carried out by adding 800 µL of dichloromethane/methanol (DCM/MeOH, 2:1 *v/v*) to the samples followed by extraction in a swing mill for 2 x 30 sec at 30 Hz. After centrifugation at 4000 rpm for 10 min, 100 µL of the clear supernatant was transferred into glass vials and dried to remove the solvent.

Arabidopsis seeds:

20 mg of seeds were transferred into tubes on a 96-format rack. The canola seed protocol was followed in all further steps.

Canola oils and commercial oil samples:

200 µL of oil was transferred into into micro tubes on a 96-format rack and closed with cap strips. Extraction of oil was carried out by adding 800 µL of dichloromethane/methanol (DCM/MeOH, 2:1 *v/v*) to the samples followed by extraction in a swing mill for 2 x 30 sec at 30 Hz. After centrifugation at 4000 rpm for 10 min, 100 µL of the clear supernatant was transferred into glass vials and dried to remove the solvent.

Normal Phase Fractionation:

The dry residues were resuspended in 100 µL 2,2,4-trimethylpentane and isopropyl alcohol (TMP/IPA (9:1, v/v)) and vortexed thoroughly. The krill oil sample was further diluted 1:30 using TMP/IPA. For triacylglycerol (TAG) isolation, the oil samples were resuspended in 500 µL TMP/IPA prior to fractionation Separation of lipid classes was performed using normal phase HPLC that leads to interaction of lipids and stationary phase based on lipid species (e.g. head group in case of phospholipids) rather than length of fatty acid chain. An Agilent 1200 series HPLC was used that comprised G1322A degasser, G1311A quaternary pump, G1310A isocratic pump, G1316A thermostatted column compartment (TCC), G1367B HiP autosampler, G1330B FC/ALS Thermostat and G1364 Fraction Collector (all Agilent) coupled to and Alltech 3300 evaporative light scattering detector (ELSD, Grace). A quaternary gradient from TMP, MTBE, acetonitrile (MeCN), DCM, formic acid (FA), ammonium formiate (0.5 M) and water was used for separation of lipid species on a PVA-Sil column (150 mm x 3 mm x 5 µm, YMC) with an initial flow rate of 0.4 mL/min. The injection volume was 50 µL. Fractions of triacylglycerol (TAG), diacylglycerol (DAG), monoacylglycerol (MAG), phosphatidylcholine (PC), phosphatidylethanolamine (PE) were collected in glass vials. The solvent was removed and the residue was resuspended in 100 µL toluene. Derivatization of lipid species into FAMEs for subsequent fatty acid profiling was carried out using 20 µL TMSH. FAME analysis was performed as described previously for Example 29 with an injection volume of 2 µL.

The results are shown in the tables 183 to 187.

Comparing the data in Table 183, 184, and 185, it is evident that the transgenic canola plants have higher percentages of EPA and DHA in DAG compared to TAG or MAG. For LBFLFK oil, the ratio of EPA in DAG to MAG is 1.6, and in LBFDAU oil the ratio is 1.5. The fact that DAG has more EPA than MAG and TAG is surprising, especially given previous reports showing that EPA and DHA are less likely to be present in the sn-2 position, at least in camelina (Ruiz-Lopez et al 2013 The Plant Journal 77, 198–208, and Petrie et al 2014 PLoS One 9(1) e85061). DAG having more EPA DHA than MAG or TAG could be taken to indicate that there is more EPA DHA at the sn-2 position of DAG.

The data in Table 186 and 187 show that PC and PE, respectively, have a higher concentration of DHA than does TAG in transgenic canola. In event LANPMZ there is 8.53% DHA in PC (and 8.5% in PE) compared to just 1% in TAG, whereas for event LBFLFK there is 3.3% DHA in PC compared to 1.2% in TAG. The more efficient accumulation of DHA in TAG relative to PC in the event LBFLFK compared to LANPMZ could be the result of having one delta-4-desaturase that is phospholipid-dependent (d4Des(Tc)) and one that is CoA-dependent (d4Des(Pl)) rather than two phospholipid-dependent enzymes in event LANPMZ.

The data in Tables 183 to 187 also show differences in the ratios between DPA and DHA for the transgenic canola samples. For all transgenic canola samples, there is more DPA than DHA in neutral lipids (MAG, DAG, and TAG), while there is more DHA than DPA in polar lipids (PC and PE).

The data in Tables 183 to 187 show that for transgenic canola samples the ratio of EPA to DHA is higher in neutral lipids (MAG, DAG, and TAG) than the ratio of EPA to DHA in polar lipids (PC, PE). There is more EPA than DHA in neutral lipids, but more DHA than EPA in polar lipids.

Table 183 (Part A): Fatty acid profile of 34 target fatty acids from monoacylgylcerol (MAG) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	14:0	16:0	16:1n-9	16:1n-7	17:0	16:3n-3	18:0	18:1n-9	18:1n-7	18:2n-9	18:2n-6 (LA)	18:3n-6 (GLA)	18:3n-3 (ALA)	18:4n-3 (SDA)	20:0	20:1n-9
LANBCH oil	MAG	0,0	6,6	0,0	0,5	0,0	0,2	3,1	24,5	7,6	0,5	30,3	1,2	4,4	0,3	0,7	0,7
LANPMZ seeds	MAG	0,0	10,6	0,0	1,0	0,0	0,5	4,7	23,2	17,6	0,0	26,1	0,6	2,8	0,0	0,5	0,0
LAODDN seeds	MAG	0,4	12,1	0,0	1,1	0,0	0,0	6,4	22,2	15,5	0,0	25,3	1,3	4,0	0,0	1,1	0,0
LBFDAU oil	MAG	0,3	6,2	0,0	0,6	0,0	0,0	2,8	24,6	7,7	0,8	28,7	1,5	5,0	0,3	0,6	0,7
LBFGKN oil	MAG	0,3	6,8	0,0	0,6	0,0	0,0	3,2	28,1	7,6	0,4	28,6	0,8	4,9	0,0	0,7	0,7
LBFLFK seeds	MAG	0,0	12,7	0,0	0,9	0,0	0,0	6,8	22,8	13,2	0,3	23,7	1,1	4,3	0,0	0,9	0,0
LBFLFK oil	MAG	0,2	6,7	0,0	0,6	0,0	0,2	3,0	25,3	8,2	0,7	28,9	1,4	4,7	0,2	0,6	0,7
Kumily oil	MAG	0,0	7,4	0,0	0,0	0,0	1,9	3,6	51,0	4,5	0,0	19,7	0,0	9,4	0,0	0,0	2,5
Canola Commodity oil	MAG	0,7	7,5	0,0	0,5	0,0	2,3	3,3	47,2	5,1	0,0	20,8	0,0	8,9	0,0	0,0	3,7
Clear Valley 65 oil	MAG	0,5	13,8	0,0	2,8	0,0	1,4	2,6	28,9	31,7	0,0	14,2	0,0	0,7	0,0	0,7	2,0
Clear Valley 80 oil	MAG	0,0	5,7	0,0	0,6	0,0	3,1	3,4	65,0	5,4	0,0	9,8	0,0	3,1	0,0	0,0	4,0
Menhaden oil	MAG	10,4	24,1	0,0	12,5	2,2	0,1	5,2	6,2	3,8	0,0	1,5	0,6	1,4	3,1	0,4	0,5
Salmon oil capsule	MAG	8,2	22,1	0,0	8,8	1,8	0,5	6,3	8,7	3,9	0,0	1,5	0,0	0,8	2,5	0,8	1,1
Krill oil capsule	MAG	5,4	21,0	0,0	3,4	0,0	1,8	3,3	7,2	6,4	0,0	1,9	0,0	0,0	2,6	0,0	1,9
DHA DHA oil capsule	MAG	7,8	24,4	0,0	1,0	0,0	0,0	3,1	10,1	0,0	0,0	3,5	0,0	0,0	0,0	0,0	0,0
Omega EPA/DHA oil capsule	MAG	2,2	25,8	0,0	0,0	0,0	0,0	3,3	16,0	0,0	0,0	3,2	0,0	0,0	0,0	0,0	0,0
Omega 3 algae oil	MAG	5,4	29,9	0,0	0,0	0,0	0,0	3,0	6,2	0,0	0,0	2,7	0,0	0,0	0,0	0,0	0,8

Table 183 (part B): Fatty acid profile of 34 target fatty acids from monoacylgylcerol (MAG) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	20:2n-9	20:3n-9	20:2n-6	20:3n-6 (DHGLA)	20:4n-6 (ARA)	20:3n-3	20:4n-3 (ETA)	20:5n-3 (EPA)	22:0	22:1n-9	22:2n-6	22:4n-6	22:5n-6	22:4n-3	22:5n-3 (DPA)	22:6n-3 (DHA)	24:0	24:0
LANBCH oil	MAG	0,3	0,3	0,2	1,8	2,8	0,8	1,0	5,4	0,7	0,0	0,0	1,9	0,0	0,3	2,8	1,3	0,2	0,2
LANPMZ seeds	MAG	0,0	0,0	0,0	1,9	2,8	0,0	1,4	3,9	0,0	0,0	0,0	0,0	0,0	0,0	1,4	1,1	0,0	0,0
LAODDN seeds	MAG	0,0	0,0	0,0	1,0	1,0	0,0	1,3	4,1	0,0	0,0	0,0	0,0	0,0	0,0	1,6	1,5	0,0	0,0
LBFDAU oil	MAG	0,3	0,2	0,2	2,8	1,9	0,0	2,0	8,0	0,0	0,0	0,0	1,3	0,0	0,0	2,2	1,4	0,0	0,0
LBFGKN oil	MAG	0,0	0,3	0,2	1,7	1,7	0,7	1,0	3,9	0,0	0,0	0,0	4,9	0,0	0,4	1,5	1,0	0,3	0,3
LBFLFK seeds	MAG	0,0	0,0	0,0	2,4	1,1	0,0	1,0	4,6	0,0	0,0	0,0	0,7	0,0	0,4	2,0	1,3	0,0	0,0
LBFLFK oil	MAG	0,2	0,3	0,2	2,7	1,4	0,0	1,7	5,9	0,0	0,0	0,0	2,1	0,0	0,4	2,3	1,1	0,3	0,3
Kumily oil	MAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Canola Commodity oil	MAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Clear Valley 65 oil	MAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,7	0,7
Clear Valley 80 oil	MAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Menhaden oil	MAG	0,1	0,0	0,3	0,5	1,5	0,0	1,4	12,3	0,0	0,0	0,0	0,0	0,0	0,1	2,2	9,6	0,2	0,2
Salmon oil capsule	MAG	0,0	0,0	0,0	0,4	1,6	0,0	0,0	17,2	0,0	0,0	0,0	0,0	0,0	0,0	2,1	11,7	0,0	0,0

Krill oil capsule	MAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	27,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	17,4	0,0	0,0
DHA DHA oil capsule	MAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	12,1	0,0	0,0	38,1	0,0	0,0
Omega EPA/DHA oil capsule	MAG	0,0	0,0	0,0	0,0	1,4	0,0	0,0	17,6	0,0	0,0	0,0	0,0	0,0	0,0	3,0	27,6	0,0	0,0
Royal Green Omega 3 algae oil	MAG	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	14,3	0,0	0,0	36,7	0,0	0,0

Table 184 (part A): Fatty acid profile of 34 target fatty acids from diacylgylcerol (DAG) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	14:0	16:0	16:1n-9	16:1n-7	17:0	16:3n-3	18:0	18:1n-9	18:1n-7	18:2n-9	18:2n-6 (LA)	18:3n-6 (GLA)	18:3n-3 (ALA)	18:4n-3 (SDA)	20:0	20:1n-9
LANBCH oil	DAG	0,0	5,4	0,0	0,0	0,0	0,0	2,6	22,0	5,0	0,8	32,7	1,4	5,8	0,0	0,0	0,0
LBFDAU oil	DAG	0,0	4,7	0,0	0,0	0,0	0,0	2,3	22,4	4,9	0,5	29,9	1,7	6,3	0,0	0,0	0,0
LBFGKN oil	DAG	0,0	5,9	0,0	0,0	0,0	0,0	2,6	25,8	4,9	0,0	33,2	1,1	7,2	0,0	0,0	0,0
LBFLFK oil	DAG	0,0	6,1	0,0	0,0	0,0	0,0	2,5	22,9	5,1	0,8	30,7	1,7	6,4	0,0	0,0	0,0
Canola Commodity oil	DAG	0,0	8,3	0,0	0,0	0,0	2,7	0,0	53,9	0,0	0,0	21,6	0,0	10,1	0,0	0,0	3,4
Clear Valley 65 oil	DAG	0,0	9,4	0,0	1,7	0,0	3,6	0,0	47,6	17,3	0,0	16,8	0,0	0,0	0,0	0,0	3,7
Clear Valley 80 oil	DAG	0,0	7,0	0,0	0,0	0,0	3,6	0,0	71,6	4,6	0,0	8,8	0,0	0,0	0,0	0,0	4,3
Menhaden oil	DAG	10,4	23,6	0,0	12,6	2,4	0,0	4,9	6,4	3,8	0,0	1,5	0,0	1,5	3,6	0,0	0,8
Salmon oil capsule	DAG	8,4	21,0	0,0	8,6	2,1	0,0	5,3	8,3	3,7	0,0	1,4	0,0	0,0	4,0	0,0	0,9
DHA DHA oil capsule	DAG	6,8	17,5	0,0	0,0	0,0	0,0	0,0	19,7	0,0	0,0	2,3	0,0	0,0	0,0	0,0	1,3

Omega EPA/DHA oil capsule	DAG	2,0	16,7	0,0	0,0	0,0	0,0	3,3	32,7	0,0	0,0	2,5	0,0	0,0	0,0	0,0	1,1
Omega 3 algae oil	DAG	5,0	20,7	0,0	0,0	0,0	0,0	3,0	11,1	0,0	0,0	1,9	0,0	0,0	0,0	0,0	0,0

Table 184 (part B): Fatty acid profile of 34 target fatty acids from diacylgylcerol (DAG) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	20:2n-9	20:3n-9	20:2n-6	20:3n-6 (DHGLA)	20:4n-6 (ARA)	20:3n-3	20:4n-3 (ETA)	20:5n-3 (EPA)	22:0	22:1n-9	22:2n-6	22:4n-6	22:5n-6	22:4n-3	22:5n-3 (DPA)	22:6n-3 (DHA)	24:0	24:1n-9
LANBCH oil	DAG	0,0	0,0	0,0	2,2	4,2	0,0	1,1	8,8	0,0	0,0	0,0	2,1	0,0	0,0	4,1	2,0	0,0	0,0
LBFDAU oil	DAG	0,0	0,0	0,0	3,2	2,8	0,0	2,4	11,7	0,0	0,0	0,0	2,1	0,0	0,0	2,7	2,5	0,0	0,0
LBFGKN oil	DAG	0,0	0,0	0,0	2,7	2,8	0,0	0,8	7,4	0,0	0,0	0,0	0,9	0,0	0,0	2,4	2,5	0,0	0,0
LBFLFK oil	DAG	0,0	0,0	0,0	3,5	2,7	0,0	2,2	9,3	0,0	0,0	0,0	1,4	0,0	0,0	3,2	1,7	0,0	0,0
Canola Commodity oil	DAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Clear Valley 65 oil	DAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Clear Valley 80 oil	DAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Menhaden oil	DAG	0,0	0,0	0,0	0,0	1,0	0,0	1,5	13,4	0,0	0,0	0,0	0,0	0,0	0,0	2,3	10,3	0,0	1,2
Salmon oil capsule	DAG	0,0	0,0	0,0	0,0	2,4	0,0	0,0	19,6	0,0	0,0	0,0	0,0	0,0	0,0	1,9	12,3	0,0	0,0
DHA DHA oil capsule	DAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	10,4	0,0	0,0	42,0	0,0	0,0

Omega EPA/DHA oil capsule	DAG	0,0	0,0	0,0	0,0	2,3	0,0	0,0	13,6	0,0	0,0	0,0	0,0	0,0	0,0	1,8	24,0	0,0	0,0
Omega 3 algae oil	DAG	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	13,9	0,0	0,0	44,5	0,0	0,0

Table 185 (part A): Fatty acid profile of 34 target fatty acids from triacylgylcerol (TAG) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	14:0	16:0	16:1n-9	16:1n-7	17:0	16:3n-3	18:0	18:1n-9	18:1n-7	18:2n-9	18:2n-6 (LA)	18:3n-6 (GLA)	18:3n-3 (ALA)	18:4n-3 (SDA)	20:0	20:1n-9
LANBCH oil	TAG	0,1	4,5	0,0	0,2	0,1	0,1	2,8	26,2	3,1	0,7	31,5	1,3	5,6	0,2	0,7	0,8
LANPMZ seeds	TAG	0,1	4,9	0,0	0,1	0,1	0,1	2,8	27,9	2,4	0,5	34,9	0,9	4,0	0,1	0,8	0,9
LAODDN seeds	TAG	0,1	5,0	0,0	0,2	0,1	0,2	2,8	29,1	2,7	0,6	35,0	1,4	5,4	0,3	0,8	0,8
LBFDAU oil	TAG	0,1	4,5	0,1	0,2	0,1	0,1	2,8	26,9	3,0	1,0	29,1	1,6	5,8	0,3	0,7	0,8
LBFGKN oil	TAG	0,1	4,3	0,0	0,2	0,1	0,1	2,7	32,4	2,9	0,5	33,0	0,9	6,8	0,2	0,7	0,8
LBFLFK seeds	TAG	0,1	4,5	0,1	0,2	0,1	0,1	2,7	28,6	3,4	0,9	30,1	1,3	5,8	0,2	0,7	0,8
LBFLFK oil	TAG	0,1	4,5	0,0	0,2	0,1	0,1	2,8	28,0	2,9	0,9	30,3	1,5	5,7	0,2	0,7	0,8
Arabidopsis seeds	TAG	0,1	6,7	0,1	0,2	0,1	0,1	5,0	7,8	1,6	0,2	21,7	0,2	17,4	0,1	3,6	18,9
Kumily seeds	TAG	0,1	4,8	0,0	0,3	0,1	0,1	2,0	59,2	0,0	0,0	20,5	0,0	10,3	0,0	0,7	1,2
Canola Commodity oil	TAG	0,1	3,9	0,0	0,2	0,1	0,1	1,8	60,0	2,9	0,0	19,0	0,0	9,3	0,0	0,6	1,3
Clear Valley 65 oil	TAG	0,0	4,1	0,0	0,2	0,1	0,1	1,8	69,5	2,2	0,0	17,6	0,0	0,8	0,0	0,8	1,5
Clear Valley 80 oil	TAG	0,0	2,9	0,0	0,1	0,1	0,1	2,6	80,0	0,0	0,0	8,2	0,0	2,3	0,0	0,9	1,8
Brassica juncea seeds	TAG	0,1	2,8	0,0	0,2	0,0	0,1	1,0	7,0	1,2	0,0	15,2	0,0	12,8	0,0	0,8	4,7
Menhaden oil	TAG	8,7	17,0	0,0	12,8	2,3	0,1	3,1	7,0	3,5	0,1	1,7	0,4	1,5	3,7	0,0	1,1
Salmon oil capsule	TAG	7,5	16,8	0,0	8,7	1,7	0,1	3,7	9,2	3,5	0,1	1,6	0,2	0,9	3,0	0,6	2,0

Krill oil capsule	TAG	21,9	21,4	0,0	11,7	0,4	0,1	1,7	17,4	8,0	0,1	2,5	0,3	1,3	5,5	0,1	1,0
DHA DHA oil capsule	TAG	5,7	15,9	0,0	0,2	0,1	0,2	1,0	15,2	0,2	0,0	1,2	0,2	0,1	0,3	0,1	0,1
Omega EPA/DHA oil capsule	TAG	1,1	15,5	0,0	0,1	0,1	0,0	1,9	25,9	0,2	0,0	2,1	0,0	0,1	0,1	0,4	0,1
Omega 3 algae oil	TAG	5,1	14,7	0,0	0,2	0,1	0,2	1,0	14,8	0,2	0,0	1,2	0,3	0,1	0,3	0,1	0,1

Table 185 (part B): Fatty acid profile of 34 target fatty acids from triacylgylcerol (TAG) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	20:2n-9	20:3n-9	20:2n-6	20:3n-6 (DHGLA)	20:4n-6 (ARA)	20:3n-3	20:4n-3 (ETA)	20:5n-3 (EPA)	22:0	22:1n-9	22:2n-6	22:4n-6	22:5n-6	22:4n-3	22:5n-3 (DPA)	22:6n-3 (DHA)	24:0	24:1n-9
LANBCH oil	TAG	0,2	0,1	0,3	1,7	3,4	0,1	1,0	7,6	0,3	0,0	0,1	1,5	0,0	0,4	4,3	1,3	0,1	0,1
LANPMZ seeds	TAG	0,5	0,2	0,5	2,2	3,5	0,2	1,0	5,7	0,4	0,0	0,1	1,3	0,0	0,4	2,4	1,0	0,2	0,2
LAODDN seeds	TAG	0,1	0,1	0,1	1,5	1,3	0,1	0,9	6,0	0,4	0,0	0,0	1,1	0,0	0,4	2,7	0,8	0,2	0,2
LBFDAU oil	TAG	0,3	0,1	0,1	3,0	2,3	0,1	1,9	10,3	0,3	0,0	0,0	0,3	0,0	0,2	2,7	1,4	0,1	0,1
LBFGKN oil	TAG	0,2	0,1	0,2	1,8	1,9	0,1	1,0	5,6	0,3	0,0	0,0	0,3	0,0	0,1	1,9	0,9	0,1	0,1
LBFLFK seeds	TAG	0,3	0,1	0,1	3,1	2,0	0,1	1,7	7,7	0,3	0,0	0,0	0,5	0,1	0,5	3,0	1,2	0,1	0,1
LBFLFK oil	TAG	0,3	0,1	0,1	3,2	2,1	0,1	1,8	8,0	0,3	0,0	0,0	0,5	0,1	0,4	3,1	1,2	0,1	0,1
Arabidopsis seeds	TAG	0,7	0,6	1,5	0,2	0,3	1,8	0,5	6,0	0,5	2,3	0,1	0,2	0,2	0,0	0,0	1,2	0,2	0,4
Kumily seeds	TAG	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,2	0,2

Canola Commodity oil	TAG	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,2	0,2
Clear Valley 65 oil	TAG	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,4	0,2
Clear Valley 80 oil	TAG	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,4	0,2
Brassica juncea seeds	TAG	0,0	0,0	0,9	0,0	0,0	0,2	0,0	0,0	1,2	49,3	1,6	0,0	0,5	0,0	0,0	0,0	0,7	2,2
Menhaden oil	TAG	0,2	0,0	0,3	0,3	1,3	0,2	1,8	16,7	0,2	0,2	0,0	0,3	0,6	0,1	2,9	12,1	0,1	0,4
Salmon oil capsule	TAG	0,2	0,0	0,2	0,2	1,7	0,1	1,1	20,0	0,2	0,4	0,0	0,2	0,5	0,1	2,6	13,0	0,1	0,6
Krill oil capsule	TAG	0,0	0,0	0,1	0,0	0,2	0,1	0,3	3,8	0,0	0,5	0,0	0,0	0,0	0,0	0,2	1,7	0,0	0,0
DHA DHA oil capsule	TAG	0,0	0,0	0,0	0,9	0,5	0,0	0,8	0,8	0,2	0,0	0,0	0,1	16,0	0,2	0,4	39,2	0,5	0,0
Omega EPA/DHA oil capsule	TAG	0,0	0,0	0,0	0,3	1,4	0,1	0,6	17,1	0,3	0,0	0,0	0,2	1,2	0,1	3,3	27,4	0,4	0,0
Omega 3 algae oil	TAG	0,0	0,0	0,0	1,0	0,6	0,1	0,9	1,2	0,2	0,0	0,0	0,1	16,9	0,1	0,6	39,9	0,3	0,0

Table 186 (part A): Fatty acid profile of 34 target fatty acids from phosphatidylcholine (PC) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	14:0	16:0	16:1n-9	16:1n-7	17:0	16:3n-3	18:0	18:1n-9	18:1n-7	18:2n-9	18:2n-6 (LA)	18:3n-6 (GLA)	18:3n-3 (ALA)	18:4n-3 (SDA)	20:0	20:1n-9
LANPMZ seeds	PC	0,0	12,7	0,6	0,3	0,1	0,1	3,4	6,6	5,8	0,0	39,2	1,8	4,5	0,3	0,0	0,0
LAODDN seeds	PC	0,0	11,5	0,4	0,7	0,0	0,0	3,1	9,7	5,9	0,0	37,0	4,5	10,1	1,5	0,0	0,0
LBFLFK seeds	PC	0,0	8,7	0,4	0,5	0,0	0,3	2,6	10,8	7,6	0,0	39,3	1,3	6,4	0,3	0,2	0,2
Arabidopsis seeds	PC	0,0	13,2	0,9	0,7	0,0	0,0	6,6	4,1	5,2	0,0	27,9	1,2	14,4	0,6	0,9	6,8
Kumily seeds	PC	0,0	6,1	0,2	0,6	0,0	0,2	0,7	57,8	2,7	0,0	27,2	0,0	4,5	0,0	0,0	0,0
Brassica juncea seeds	PC	0,0	12,3	0,0	1,8	0,0	1,1	1,5	29,4	4,6	0,0	34,4	0,0	12,0	0,0	0,0	1,9
Krill oil capsule	PC	3,1	26,5	0,0	1,7	0,1	0,0	1,0	4,6	5,5	0,2	2,1	0,3	1,5	3,0	0,0	0,3

Table 186 (part B): Fatty acid profile of 34 target fatty acids from phosphatidylcholine (PC) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	20:2n-9	20:3n-9	20:2n-6	20:3n-6 (DHGLA)	20:4n-6 (ARA)	20:3n-3	20:4n-3 (ETA)	20:5n-3 (EPA)	22:0	22:1n-9	22:2n-6	22:4n-6	22:5n-6	22:4n-3	22:5n-3 (DPA)	22:6n-3 (DHA)	24:0	24:1n-9
LANPMZ seeds	PC	0,0	0,0	0,0	0,7	0,0	0,3	7,0	7,3	0,0	0,0	0,0	0,0	0,0	0,0	0,4	9,0	0,0	0,0
LAODDN seeds	PC	0,0	0,0	0,0	0,2	0,0	0,0	6,8	3,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,3	0,0	0,0

LBFLFK seeds	PC	0,1	0,0	0,0	0,9	0,0	0,1	10,9	4,1	0,0	0,0	0,0	0,0	0,0	0,2	1,8	3,3	0,0	0,0
Arabidopsis seeds	PC	0,0	0,0	0,0	0,0	0,0	2,8	1,0	6,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,2	0,0	0,0
Kumily seeds	PC	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brassica juncea seeds	PC	0,0	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Krill oil capsule	PC	0,1	0,0	0,1	0,2	0,7	0,0	1,0	33,3	0,0	0,6	0,0	0,0	0,0	0,0	0,6	13,6	0,0	0,1

Table 187 (part A): Fatty acid profile of 34 target fatty acids from phosphatidylethanolamine (PE) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	14:0	16:0	16:1n-9	16:1n-7	17:0	16:3n-3	18:0	18:1n-9	18:1n-7	18:2n-9	18:2n-6 (LA)	18:3n-6 (GLA)	18:3n-3 (ALA)	18:4n-3 (SDA)	20:0	20:1n-9
LANPMZ seeds	PE	0,0	18,3	0,0	0,0	0,0	0,0	3,1	5,8	6,4	0,0	36,4	1,3	4,4	0,0	0,0	0,0
LAODDN seeds	PE	0,0	17,7	0,0	0,0	0,0	0,0	3,3	7,9	6,0	0,0	33,6	3,0	8,5	0,0	0,0	0,0
LBFLFK seeds	PE	0,0	15,5	0,0	0,0	0,0	0,0	2,9	8,6	7,3	0,0	37,6	1,2	6,1	0,0	0,0	0,0
Arabidopsis seeds	PE	0,0	18,7	0,4	0,0	0,0	0,0	5,6	2,4	4,6	0,0	27,1	0,0	13,2	0,0	0,0	4,1
Brassica juncea seeds	PE	0,0	19,1	0,0	1,1	0,0	2,1	0,0	13,4	4,5	0,0	41,4	0,0	13,3	0,0	0,0	4,1
Krill oil capsule	PE	1,1	16,6	0,0	0,0	0,0	2,9	0,0	4,1	13,6	0,0	0,0	0,0	0,0	0,0	0,0	4,0

Table 187 (part B): Fatty acid profile of 34 target fatty acids from phosphatidylethanolamine (PE) fraction after DCM/MeOH (2:1) extraction, normal phase fractionation, derivatization to FAMES and analysis by GC-FID. Data are mean, n=2 and FA expressed as peak area % from total peak area

sample name	Fraction	20:2n-9	20:3n-9	20:2n-6	20:3n-6 (DHGLA)	20:4n-6 (ARA)	20:3n-3	20:4n-3 (ETA)	20:5n-3 (EPA)	22:0	22:1n-9	22:2n-6	22:4n-6	22:5n-6	22:4n-3	22:5n-3 (DPA)	22:6n-3 (DHA)	24:0	24:1n-9
LANPMZ seeds	PE	0,0	0,0	0,0	1,0	6,5	0,0	4,1	4,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,5	0,0	0,0
LAODDN seeds	PE	0,0	0,0	0,0	0,0	7,5	0,0	4,2	2,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,9	0,0	0,0
LBFLFK seeds	PE	0,0	0,0	0,0	1,2	3,6	0,0	8,1	3,3	0,0	0,0	0,0	0,0	0,0	0,0	0,9	3,6	0,0	0,0
Arabidopsis seeds	PE	0,0	0,0	0,0	0,0	11, 0	0,5	0,0	4,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,7	0,0	0,0
Brassica juncea seeds	PE	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Krill oil capsule	PE	0,0	0,0	0,0	0,0	2,5	0,0	0,0	24,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	30,4	0,0	0,0

Example 31: Phospholipid species profiling

Diluted extracts from Example 30 were used for phospholipid species analysis

PC species profiling

Phosphatidylcholine (PC) species separation was carried out on a 1290 Agilent HPLC coupled to API5500 triple quadrupole MS (ABSciex). HPLC comprised of G4227A Flex Cube, G4226A autosampler, G1330B thermostat and G4220A binary pump. PC species separation was carried out on a Phenomenex Kinetex C8 column (150 mm x 2.1 mm x 1.7 µm). The mobile phase consisted of H_2O/MeOH/sodium acetate (50 mM) as solvent A and MeOH/sodium acetate (50 mM) as solvent B with a flow rate of 0.5 mL/min. The initial conditions were 40% A followed by a linear gradient to 25% A in a total run time of 7 min. MS was operated in positive ESI mode with a source temperature of 550 °C using scheduled multiple reaction monitoring (sMRM) and an injection volume of 1 µL. Data acquisition was carried out using Analyst 1.5.1 whereas data analysis was done in Multiquant 3.0.1 (AB Sciex). All theoretical $[M+Na]^+$ from phosphatidylcholine species containing C14:0, C16:0, C16:1, C18:0, C18:1, C18:2, C18:3, C20:3, C20:4, C20:5, C22:5 and C22:6 fatty acids were calculated resulting in a total of 78 PC species. In sMRM-mode, the neutral loss of fatty acids was monitored. MRMs of PC species not present in a representative set of test samples from different canola, fish and algae oil sources were removed from the transition list.

All peak areas of target PC species were added to a total peak area. Species with peak areas lower than 10.000 counts were not included in the calculation as they were considered below limit of quantitation having a poor signal-to-noise ratio. PC species profile was then calculated as PC species percent of total PC species.

LPC species profiling

Lysophosphatidylcholine (LPC) species separation was carried out on a 1290 Agilent HPLC coupled to API5500 triple quadrupole MS (ABSciex). HPLC comprised of G4227A Flex Cube, G4226A autosampler, G1330B thermostat and G4220A binary pump. LPC species separation was carried out on a Phenomenex Kinetex C8 column (150 mm x 2.1 mm x 1.7 µm). The mobile phase consisted of H_2O/MeOH/formic as solvent A and MeOH as solvent B with a flow rate of 0.5 mL/min and a linear gradient from 80% A to 0% A over a total run time of 4 min. MS was operated in positive ESI mode with a source temperature of 550 °C using multiple reaction monitoring (MRM) and an injection volume of 1 µL. Data acquisition was carried out using Analyst 1.5.1 whereas data analysis was done in Multiquant 3.0.1 (AB Sciex). All theoretical $[M+H]^+$ from LPC species containing C14:0, C16:0, C16:1, C18:0, C18:1, C18:2, C18:3, C20:3, C20:4, C20:5, C22:5 and C22:6 fatty acids were calculated. In sMRM-mode, the neutral loss of fatty acids was monitored.

All peak areas of target LPC species were added to a total peak area. Species with peak areas lower than 12.500 counts were not included in the calculation as they were considered below limit of quantitation having a poor signal-to-noise ratio. LPC species profile was then calculated as LPC species percent of total LPC species.

PE/LPE species profiling

Phosphatidylethanolamine (PE) and lysophosphatidylethanolamine (LPE) species separation was carried out on a 1290 Agilent HPLC coupled to API5500 triple quadrupole MS (ABSciex). HPLC comprised of G4227A Flex Cube, G4226A autosampler, G1330B thermostat and G4220A binary pump. PE/LPE species separation was carried out on a Phenomenex Kinetex C8 column (150 mm x 2.1 mm x 1.7 µm). The mobile phase consisted of H_2O/MeOH/ammonium formate as solvent A and MeOH/ ammonium formate as solvent B with a flow rate of 0.5 mL/min. The initial conditions were 100% A followed by a linear gradient to 0% A over a total run time of 16 min. MS was operated in negative ESI mode with a source temperature of 550 °C using scheduled multiple reaction monitoring (sMRM) and an injection volume of 1 µL. Data acquisition was carried out using Analyst 1.5.1 whereas data analysis was done in Multiquant 3.0.1 (AB Sciex). All theoretical $[M-H]^-$ from PE and LPE species containing C14:0, C16:0, C16:1, C18:0, C18:1, C18:2, C18:3, C20:3, C20:4, C20:5, C22:5 and C22:6 fatty acids were calculated resulting in a total of 78 PE species and 12 LPE species.

MRMs of PE/LPE species not present in a representative set of test samples from different canola, fish and algae oil sources were removed from the transition list.

All peak areas of target PE species and LPE species were added to a total peak area separately. The peak area cut-off for LPE not included into the calculation due to poor signal-to-noise was 2000 counts, for PE it was 5000 counts. PE and LPE species profile were then calculated as PE species percent of total PE species and LPE species percent of total LPE species.

The results are shown in Tables 188 to 191.
Many more phospholipid species were detectable in seed samples than in oil samples. This is probably due to the fact that phospholipids are removed during oil refinement. Tables 186 and 187 showed that for transgenic canola samples PC contains the most DHA of any lipid fraction. For all transgenic canola samples the most abundant PC species containing DHA is PC 18:2 22:6 and the most abundant PC species containing EPA is PC 18:2 20:5 (Table 188). DHA was found in the PC of fish oil and algal oil samples, but only in PC 18:3 22:6. One exception was krill oil, but PC 18:2 22:6 totalled just 0.1% of PC species. The most abundant PE species containing DHA is PE 18:2 22:6 (Table 190).The PC species that decreased the most in transgenic canola samples was PC 18:1 18:1, where PC 18:2 18:2 is the species that increased the most. Accordingly, LPC 18:2 is the most abundant lysoPC species in transgenic canola samples.

Table 188: Phosphatidylcholine species profile of occurring PC species comprising 12 target fatty acids from DCM/MeOH (2:1) extracts analyzed by +ESI-HPLC-MS/MS in sMRM mode. Data are mean, n=2-3 and expressed as relative abundance of species. Species that were not detected in any samples were removed from the table

Sample Name	LANBCH oil	LANPMZ seeds	LAODDN seeds	LBFDAU oil	LBFGKN seeds	LBFGKN oil	LBFLFK seeds	LBFLFK oil	Arabidopsis seeds	Kumily seeds	Kumily oil	Canola Commodity oil	Clear Valley 65 oil	Clear Valley 80 oil	Brassica juncea seeds	Salmon oil capsule	Krill oil capsule	DHA DHA oil capsule	Omega EPA/DHA oil capsule	Omega 3 algae oil
PC140 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,0	0,0	0,0
PC140 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,4	0,0	0,0	0,0
PC140 182	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0
PC140 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0	0,0
PC140 204	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0
PC140 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,5	0,0	0,0	0,0
PC140 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PC140 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,7	0,0	0,0	0,0
PC160 160	0,5	0,7	0,4	0,4	0,3	0,0	0,4	0,9	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0
PC160 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0
PC160 180	0,0	0,3	0,2	0,0	0,2	0,0	0,3	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PC160 181	4,9	4,8	5,2	4,6	6,6	7,5	5,8	4,5	3,7	11,5	12,9	12,5	15,9	9,0	11,8	0,0	10,8	3,4	6,1	6,4
PC160 182	12,4	11,7	10,3	12,6	8,8	10,1	7,6	11,5	11,6	7,5	6,7	7,3	7,4	0,0	11,4	0,0	3,9	14,7	12,9	20,5
PC160 183	3,9	2,3	4,7	3,5	2,0	4,8	1,8	3,4	8,2	3,2	1,9	1,7	0,7	0,0	8,1	0,0	1,8	0,0	0,0	0,0
PC160 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0

PC160 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	13,0	0,0	0,0	0,0
PC160 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,0	0,0	0,0
PC160 226	0,0	2,7	1,5	0,0	1,3	0,0	1,2	0,0	2,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,4	0,0	0,0	0,0
PC161 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0
PC161 180	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PC161 181	0,0	0,3	0,4	0,0	0,4	0,0	0,5	0,0	0,7	0,7	0,0	0,8	0,3	0,8	0,4	0,0	0,9	0,0	0,0	0,0
PC161 182	0,0	0,8	0,7	0,0	0,5	0,0	0,4	0,0	1,7	1,1	0,0	0,8	0,6	0,0	1,6	0,0	0,2	0,0	0,0	0,3
PC161 183	0,0	0,3	0,7	0,0	0,3	0,0	0,4	0,0	0,6	0,5	0,0	0,0	0,0	0,0	1,2	0,0	2,7	0,0	0,0	0,0
PC161 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PC161 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,4	0,0	0,0	0,0
PC161 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,7	0,0	0,0	0,0
PC180 181	0,0	0,5	0,6	0,0	1,4	0,0	1,2	0,0	0,8	1,8	0,0	0,8	0,8	0,0	1,7	0,0	0,2	0,0	0,0	1,2
PC180 182	3,6	5,2	4,3	3,7	3,8	0,0	4,0	2,9	6,6	0,2	0,2	0,0	0,1	0,0	0,8	0,0	0,3	3,2	3,3	6,1
PC180 183	0,0	1,0	1,8	0,0	0,7	0,0	0,8	0,0	4,1	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,3	0,0	0,0	0,0
PC180 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,2	0,0	0,0	0,0
PC180 226	0,0	0,8	0,6	0,0	0,4	0,0	0,3	0,0	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0
PC181 181	5,8	3,4	4,2	7,0	7,8	15,5	8,0	6,6	2,3	26,8	36,1	28,0	32,9	66,0	15,2	29,5	4,4	9,0	18,6	7,5
PC181 182	15,8	13,5	13,1	17,8	16,7	19,4	16,0	17,6	9,3	24,4	27,4	27,0	28,6	19,1	18,7	0,0	2,2	19,2	16,9	24,5
PC181 183	3,4	2,7	5,1	4,1	3,5	4,3	3,8	3,9	4,4	7,0	5,0	6,0	1,8	4,9	7,4	0,0	0,7	0,0	0,0	0,0
PC181 204	3,0	1,9	1,8	4,9	2,6	3,5	4,6	4,2	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0
PC181 205	0,0	1,2	0,7	0,0	1,2	0,0	1,3	0,0	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,5	0,0	0,0	0,0
PC181 226	0,0	1,4	1,0	0,0	1,1	0,0	1,2	0,0	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,1	0,0	0,0	0,0
PC182 182	17,8	12,5	10,7	17,4	13,8	16,8	12,4	17,2	10,8	8,4	6,8	10,2	10,3	0,0	8,7	32,1	0,1	49,7	35,2	33,3
PC182 183	7,6	7,2	12,4	7,4	8,6	7,6	8,4	9,1	11,6	5,9	3,1	4,3	0,7	0,2	9,3	0,0	0,1	0,0	0,0	0,1
PC182 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0

PC182 204	5,7	4,7	4,5	7,2	4,9	4,0	7,3	7,9	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PC182 205	9,7	8,6	3,0	5,8	4,5	3,3	4,1	5,3	2,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0
PC182 226	5,9	3,9	2,2	2,4	2,2	3,3	1,4	2,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PC183 183	0,0	1,6	5,2	0,0	2,3	0,0	2,2	0,6	5,9	1,2	0,0	0,5	0,0	0,0	3,3	0,0	0,0	0,0	0,0	0,0
PC183 205	0,0	2,4	1,9	0,0	1,7	0,0	1,6	0,7	2,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0
PC183 226	0,0	1,4	1,8	0,0	1,0	0,0	0,7	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0	38,4	0,1	0,8	7,0	0,0
PC204 204	0,0	0,7	0,7	1,3	0,8	0,0	1,9	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PC205 205	0,0	0,7	0,1	0,0	0,3	0,0	0,4	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,5	0,0	0,0	0,0
PC205 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PC205 226	0,0	1,0	0,3	0,0	0,4	0,0	0,3	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,9	0,0	0,0	0,0
PC226 226	0,0	0,4	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,0	0,0	0,0

Table 189: Lysophosphatidylcholine species profile of occurring LPC species comprising 12 target fatty acids from DCM/MeOH (2:1) extracts analyzed by +ESI-HPLC-MS/MS in MRM mode. Data are mean, n=2-3 and expressed as relative abundance of species. Species that were not detected in any samples were removed from the table

Sample Name	LANBCH oil	LANPMZ seeds	LAODDN seeds	LBFDAU oil	LBFGKN seeds	LBFGKN oil	LBFLFK seeds	LBFLFK oil	Arabidopsis seeds	Kumily seeds	Menhaden oil	Salmon oil capsule	Krill oil capsule	DHA DHA oil capsule	Omega EPA/DHA oil capsule	Omega 3 algae oil
LPC 14:0	0,0	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	4,4	0,0	0,0	0,0
LPC 16:0	2,8	14,5	14,2	2,9	11,0	2,3	11,7	1,9	18,1	7,4	28,7	47,3	37,2	10,8	11,1	13,4
LPC 16:1	2,0	2,3	2,0	2,0	1,6	2,2	1,6	2,0	2,8	1,3	0,0	0,0	3,2	0,0	0,0	0,0
LPC 18:0	0,8	2,5	3,1	1,0	2,2	0,6	2,5	0,5	9,1	0,8	48,0	0,0	1,4	5,5	11,4	5,0
LPC 18:1	13,4	16,9	16,8	15,8	22,1	26,5	21,8	14,0	13,0	56,2	13,2	21,1	13,7	23,4	29,1	20,4

LPC 18:2	46,4	33,8	32,9	48,8	38,5	47,4	34,8	45,3	23,7	28,9	0,0	0,0	2,2	60,4	48,4	60,9
LPC 18:3	7,0	6,7	14,7	6,8	8,2	6,7	8,0	8,9	14,0	5,5	0,0	0,0	1,6	0,0	0,0	0,0
LPC 20:3	1,7	0,9	0,4	1,0	0,8	0,5	1,0	0,9	3,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0
LPC 20:4	9,1	6,5	6,3	10,8	6,7	5,9	10,3	13,3	2,4	0,0	0,0	0,0	1,0	0,0	0,0	0,0
LPC 20:5	5,6	6,7	3,5	4,0	3,8	2,6	3,7	4,8	5,6	0,0	10,2	21,1	22,8	0,0	0,0	0,4
LPC 22:5	1,4	0,8	0,7	1,3	0,7	0,6	1,2	3,1	0,5	0,0	0,0	0,0	1,2	0,0	0,0	0,0
LPC 22:6	9,8	8,4	5,4	5,6	4,4	4,7	3,4	5,3	7,7	0,0	0,0	10,5	11,1	0,0	0,0	0,0

Table 190: Phosphatidylethanolamine species profile of occurring PE species comprising 12 target fatty acids from DCM/MeOH (2:1) extracts analyzed by -ESI-HPLC-MS/MS in sMRM mode. Data are mean, n=2-3 expressed as relative abundance of species. Species that were not detected in any samples were removed from the table

Sample Name	LANBCH oil	LANPMZ seeds	LAODDN seeds	LBFDAU oil	LBFGKN seeds	LBFGKN oil	LBFLFK seeds	LBFLFK oil	Arabidopsis seeds	Kumily seeds	Kumily oil	Canola Commodity oil	Clear Valley 65 oil	Clear Valley 80 oil	Brassica juncea seeds	Menhaden oil	Salmon oil capsule	Krill oil capsule	DHA DHA oil capsule	Omega EPA/DHA oil capsule	Omega 3 algae oil
PE140 160	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,4	0,0	0,0	0,0
PE140 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0
PE140 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,3	0,0	0,0	0,0	0,0	2,1	0,0	0,0	0,0
PE140 182	0,0	1,1	0,6	0,4	0,6	0,0	0,5	0,4	0,5	0,4	0,0	0,4	0,5	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0
PE140 183	0,0	0,1	0,2	0,0	0,1	0,0	0,1	0,0	0,2	0,1	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,1	0,0	0,0	0,0
PE140 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0
PE140 204	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PE140 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,7	0,0	0,0	0,0

PE140 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0	0,0	0,0
PE160 160	0,3	0,1	0,1	0,2	0,1	0,0	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,0	0,0	0,3
PE160 161	0,5	0,5	0,4	0,0	0,4	0,0	0,4	0,5	1,1	0,3	0,0	0,0	0,0	0,0	1,0	0,0	0,0	4,2	0,0	0,0	0,0
PE160 180	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PE160 181	5,0	1,9	2,4	5,4	3,0	6,6	2,6	6,0	1,8	9,7	14,7	19,0	11,4	13,0	7,2	0,0	0,0	9,9	3,1	0,0	2,5
PE160 182	26,6	22,2	17,9	24,7	17,6	23,2	21,2	22,0	26,0	9,8	13,5	12,9	12,3	4,9	19,5	0,0	0,0	6,9	25,7	35,7	30,0
PE160 183	3,0	4,6	10,4	2,9	4,7	3,7	4,8	3,7	14,6	2,4	2,4	2,0	0,3	0,0	8,4	0,0	0,0	6,1	0,0	0,0	0,0
PE160 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0
PE160 204	1,4	2,0	1,1	1,4	1,6	0,0	2,3	1,6	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0
PE161 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0
PE161 180	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PE161 181	0,2	0,2	0,3	0,3	0,5	0,0	0,4	0,5	0,5	1,0	1,0	0,8	0,8	1,8	0,9	0,0	0,0	4,0	0,0	0,0	0,0
PE161 182	0,9	1,1	0,9	0,8	1,2	1,0	0,9	0,9	1,6	1,5	1,0	1,1	1,1	0,0	2,1	0,0	0,0	0,5	0,0	0,0	0,0
PE161 204	0,0	0,0	0,0	0,0	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2	0,0	0,0	0,0
PE180 181	0,0	0,1	0,1	0,1	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0
PE180 182	2,6	2,5	1,8	2,7	1,7	2,0	2,2	2,5	3,6	0,4	0,7	0,4	0,4	0,0	1,0	0,0	0,0	0,0	9,5	0,0	11,6
PE180 183	0,0	0,3	0,7	0,2	0,4	0,0	0,4	0,0	2,3	0,1	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0
PE180 226	0,0	0,1	0,1	0,0	0,1	0,0	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PE181 181	1,9	1,0	1,2	2,4	2,8	4,6	2,0	3,4	0,6	20,6	14,1	13,2	22,3	38,9	4,9	100,0	10 0,0	3,4	10,0	23,0	8,7
PE181 182	13,7	12,8	13,5	14,2	16,3	17,0	14,8	14,5	6,9	26,7	27,6	25,6	35,1	28,7	19,8	0,0	0,0	1,4	10,1	2,4	7,2
PE181 183	2,2	1,9	4,8	2,6	3,3	3,2	3,7	2,9	3,8	5,2	5,6	4,0	0,8	3,9	5,2	0,0	0,0	1,2	0,0	0,0	0,0
PE181 204	0,8	0,5	0,5	1,8	1,3	1,0	1,9	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0

PE181 226	0,5	0,6	0,5	0,2	0,7	0,0	0,6	0,4	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	20,9	0,0	0,0	0,0
PE182 182	17,8	21,0	11,6	16,0	18,8	19,0	15,7	15,7	13,5	14,6	13,3	15,7	13,7	7,5	16,9	0,0	0,0	0,5	41,6	38,9	39,9
PE182 183	11,0	13,1	18,2	11,5	14,1	12,3	12,0	12,0	13,7	6,3	5,6	4,6	0,9	1,4	9,4	0,0	0,0	0,0	0,0	0,0	0,0
PE182 203	0,7	0,4	0,0	0,6	0,4	0,0	0,5	0,5	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PE182 204	4,7	4,9	4,4	7,1	4,0	4,7	7,0	5,7	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
PE182 225	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PE182 226	2,1	3,3	1,4	0,9	1,6	0,0	1,1	0,6	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,6	0,0	0,0	0,0
PE183 183	1,8	1,1	4,0	1,6	1,9	1,7	1,4	1,9	4,6	0,8	0,6	0,4	0,0	0,0	2,5	0,0	0,0	0,0	0,0	0,0	0,0
PE183 204	1,0	1,0	1,7	1,4	1,5	0,0	2,2	1,7	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
PE183 226	0,7	0,9	0,9	0,3	0,6	0,0	0,4	0,3	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0	0,0
PE203 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2	0,0	0,0	0,0
PE203 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0
PE204 205	0,3	0,2	0,1	0,3	0,3	0,0	0,2	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0
PE204 226	0,0	0,3	0,2	0,1	0,2	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,1	0,0	0,0	0,0
PE205 205	0,2	0,1	0,1	0,1	0,1	0,0	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	10,6	0,0	0,0	0,0
PE226 226	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,6	0,0	0,0	0,0

Table 191: Lysophosphatidylethanolamine species profile of occurring LPE species comprising 12 target fatty acids from DCM/MeOH (2:1) extracts analyzed by -ESI-HPLC-MS/MS in sMRM mode. Data are mean, n=2-3 expressed as relative abundance of species. Species that were not detected in any samples were removed from the table

Sample Name	LANBCH oil	LANPMZ seeds	LAODDN seeds	LBFDAU oil	LBFGKN seeds	LBFGKN oil	LBFLFK seeds	LBFLFK oil	Arabidopsis seeds	Kumily seeds	Canola Commodity oil	Clear Valley 65 oil	Clear Valley 80 oil	Brassica juncea seeds	Salmon oil capsule	Krill oil capsule	DHA DHA oil capsule	Omega EPA/DHA oil capsule	Omega 3 algae oil
LPE14:0	0,0	0,2	0,2	0,0	0,1	0,0	0,1	0,0	0,2	0,1	0,1	0,1	0,0	0,1	0,0	0,6	0,0	0,0	0,0
LPE16:0	1,9	18,8	20,8	2,5	14,8	1,6	14,7	1,7	22,5	9,7	5,0	8,2	7,7	24,8	19,1	23,4	9,9	17,0	20,5
LPE16:1	0,6	0,7	0,6	0,6	0,5	0,7	0,5	0,7	0,8	1,1	0,5	0,6	0,3	1,1	0,0	1,2	0,0	0,0	0,0
LPE18:0	1,2	3,0	3,6	1,7	2,7	1,2	3,0	1,0	9,5	0,8	1,4	1,7	4,6	8,6	0,0	1,9	2,5	1,2	4,2
LPE18:1	7,1	15,1	16,4	9,8	19,2	13,6	19,5	7,6	12,1	42,1	48,5	61,1	71,7	23,6	25,6	23,7	14,8	17,9	11,9
LPE18:2	54,5	35,7	29,7	57,8	38,1	59,8	33,8	62,3	24,3	39,6	40,5	27,7	14,2	32,4	42,6	1,6	72,8	64,0	63,4
LPE18:3	6,7	6,8	13,8	7,2	9,0	7,2	8,5	8,9	12,7	6,6	4,0	0,6	1,5	9,4	0,0	0,7	0,0	0,0	0,0
LPE20:3	0,3	0,6	0,2	0,2	0,5	0,1	0,7	0,1	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0
LPE20:4	3,4	5,1	5,9	4,6	6,2	2,7	10,6	3,5	1,5	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0
LPE20:5	6,3	4,9	3,1	5,3	3,9	3,3	3,7	5,0	5,2	0,0	0,0	0,0	0,0	0,0	12,8	24,8	0,0	0,0	0,0
LPE22:5	0,2	0,1	0,1	0,2	0,2	0,1	0,5	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0
LPE22:6	18,0	9,0	5,6	10,1	4,8	9,6	4,3	8,4	10,2	0,0	0,0	0,0	0,0	0,0	0,0	19,3	0,0	0,0	0,0

Example 32: TAG species analysis

Diluted extracts from Example 29 were used for TAG (triacylglycerol) species analysis. TAG species analysis was carried out on a 1290 Agilent HPLC coupled to API5500 triple quadrupole MS (ABSciex). HPLC comprised of G4227A Flex Cube, G4226A autosampler, G1330B thermostat and G4220A binary pump. TAG species separation was carried out on a Thermo Accucore C30 column (250 mm x 2.1 mm x 2.6 µm). The mobile phase consisted of MeCN/IPA as solvent A and IPA as solvent B with a flow rate of 0.4 mL/min. Starting conditions were 100% followed by a linear gradient to 20% A with a total run time of 30 min. The Injection volume was 1 µL. The mass spectrometer was operated in positive APCI mode with ion source temperature of 300 °C using scheduled multiple reaction monitoring (sMRM). Data acquisition was carried out using Analyst 1.5.1 whereas data analysis was done in Multiquant 3.0.1 (AB Sciex). All theoretical $[M+H]^+$ from TAG species containing C14:0, C16:0, C16:1, C18:0, C18:1, C18:2, C18:3, C20:3, C20:4, C20:5, C22:5 and C22:6 fatty acids were calculated resulting in a total of 364 TAG species. In MRM-mode, the neutral loss of fatty acids was monitored, therefore all theoretical product ions were calculated as well. The first quadrupole was set to filter only those $[M+H]^+$ of target TAG species that were subsequently fragmented in the second quadrupole which led to the loss of fatty acid. For TAG species containing three different fatty acids, three product ions were monitored in the third quadrupole whereas those species with two different fatty acids led to two product ions. In case of TAG species with only one fatty acid, only one transition could be monitored.

Single and mixed standards of TAGs (16:0/16:0/16:0), (16:1/16:1/16:1), (17:0/17:0/17:0), (18:0/18:0/18:0), (18:1/18:1/18:1), (18:2/18:2/18:2), (18:3/18:3/18:3), (20:5/20:5/20:5), (22:6/22:6/22:6), (16:0/16:0/18:1), (16:0/18:0/18:2), (16:0/18:1/18:1), (16:0/18:2/18:2), (18:0/18:0/18:2), (18:0/18:1/18:1), (18:0/18:1/18:2), (18:1/18:1/18:3) and (18:1/18:2/18:2) were run to identify retention time patterns among TAG species. MRMs of TAG species not present in a representative set of test samples from different canola, fish and algae oil sources were removed from the transition list. For all other species, a retention time was identified to allow for scheduled monitoring of MRM in a given time window which allows for more data points per transition thus leading to a better quality of data.

Baseline separation of all TAG species could not be achieved within a reasonable runtime, therefore peak heights were used instead of peak areas. The sums of all transitions with were used to calculate a total peak height. Species with peak height lower than 1000 counts were not included in the calculation as they were considered below limit of quantitation having a poor signal-to-noise ratio. TAG species profile was then calculated as TAG species percent of total TAG species.

The results are shown in Table 192.
The five most abundant TAG species in Kumily oil are TAG 181 181 183, TAG 181 182 183, TAG 181 181 182, TAG 181 181 181, and TAG 181 182 182. Together, these account for 64.5% of all TAG species. These species are specifically reduced in the transgenic canola samples, where there sum total ranges from 14.3 to 21.2%. Instead, the most abundant single TAG species in the

transgenic canola lines is TAG 181 182 205, followed by TAG 181 181 205 and TAG 182 182 205. Together, these three species make up 20.6 to 25.5% of the total TAG species observed in transgenic canola samples. The two most abundant DHA containing TAG species in the transgenic canola samples are TAG 181 182 226 and TAG 182 182 226, which together represent from 1.5 to 3.3% of all TAG species. It is notable that EPA and DHA are found most frequently esterified to TAG together with 18:1 and 18:2. This makeup is likely to be more oxidatively stable that TAG species containing multiple PUFAs. In the transgenic canola samples, the sum of all TAG species with a single EPA, DPA, or DHA is 42.3 to 50.3%, whereas the sum of all TAG species with more than one EPA, DPA, and/or DHA is 3.4 to 6.6%. In fish and algal oils, the sum of all TAG species with more than one EPA, DPA, and/or DHA ranges from 21.1 to 60.3%. Therefore, the transgenic canola samples have the highest proportion of oxidatively stable TAG species. The transgenic canola samples also have a low abundance of TAG 183 183 205 and TAG 183 183 226, with a range of just 0.2 to 0.6% of total TAG species.

Table 192: Triacylglycerol sspecies profile of occurring TAG species comprising 12 target fatty acids from MTBE extracts analyzed by +APCI-HPLC-MS/MS in sMRM mode. Data are mean, n=2 expressed as relative abundance of species. Species that were not detected in any samples were removed from the table

Sample name	LANBCH oil	LANPMZ seeds	LAODDN seeds	LANBCH oil	LBFGKN oil	LBFLFK seeds	LBFLFK oil	Arabidopsis seeds	Kumily seeds	Kumily oil	Canola Commodity oil	Clear Valley 65 oil	Clear Valley 80 oil	Brassica juncea seeds	Menhaden oil	Salmon oil capsule	Krill oil capsule	DHA DHA oil capsule	Omega EPA/DHA oil	Omega 3 algae oil
TAG 140 140 140	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,1
TAG 140 140 160	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,1
TAG 140 140 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,7	10,8	0,0	0,0	0,0
TAG 140 140 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,4	10,5	0,0	0,0	0,0
TAG 140 140 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,2	2,1	0,0	0,0	0,0

TAG 140 140 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,7	7,0	3,3	0,3	0,4	0,4
TAG 140 140 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,5	0,0	2,7
TAG 140 140 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,4	2,0	1,2	10,5	1,0	10,4
TAG 140 160 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,6	15,4	0,0	0,0	0,0
TAG 140 160 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	1,4	15,7	0,0	0,0	0,0
TAG 140 160 182	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	2,5	0,0	0,0	0,0
TAG 140 160 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,3	10,1	8,8	0,0	2,0	0,0
TAG 140 160 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,1	4,4	2,5	23,9	3,7	21,2
TAG 140 161 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,7	2,4	0,0	0,0	0,0
TAG 140 161 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,3	0,0	0,0	0,0	0,0
TAG 140 161 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	8,4	7,0	2,9	0,0	0,0	0,0
TAG 140 161 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,7	1,7	0,0	0,0	0,0	0,4
TAG 140 181 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,4	5,0	0,0	0,0	0,0

TAG 140 205 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,6	3,4	0,0	0,1	1,2	0,2
TAG 140 205 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,4	2,2	0,0	1,3	3,6	1,1
TAG 160 160 181	0,1	0,1	0,2	0,1	0,1	0,1	0,0	0,1	0,2	0,2	0,1	0,3	0,2	0,5	0,2	0,3	0,9	0,0	0,0	0,0
TAG 160 160 182	0,5	0,3	0,3	0,5	0,4	0,3	0,4	1,1	0,4	0,2	0,4	0,3	0,2	2,3	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 160 183	0,3	0,2	0,2	0,3	0,3	0,3	0,3	2,4	0,8	0,5	0,5	0,0	0,0	7,3	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 160 205	0,2	0,2	0,2	0,2	0,1	0,3	0,2	0,6	0,0	0,0	0,0	0,0	0,0	0,0	2,9	3,6	1,4	0,0	5,9	0,0
TAG 160 160 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,7	0,0
TAG 160 160 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,1	2,6	0,0	11,3	12,6	8,8
TAG 160 161 161	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,8	0,8	0,0	0,0	0,0	0,0
TAG 160 161 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,4	0,7	3,3	0,0	0,0	0,0
TAG 160 161 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	6,1	8,3	1,5	0,0	0,0	0,0
TAG 160 161 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,7	1,0	0,0	0,0	0,0	0,0
TAG 160 161 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,7	0,0	0,0	1,1	0,3	0,7

TAG 160 180 181	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,3	0,2	0,2	0,2	0,3	0,5	0,4	0,1	0,1	0,1	0,1	0,1	0,1
TAG 160 180 182	0,1	0,2	0,3	0,1	0,1	0,1	0,1	0,5	0,1	0,1	0,1	0,1	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 180 183	0,2	0,2	0,2	0,2	0,2	0,2	0,1	2,6	0,3	0,2	0,2	0,0	0,1	1,9	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 180 205	0,0	0,1	0,1	0,0	0,0	0,1	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,5	0,0	0,0	0,8	0,0
TAG 160 180 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0
TAG 160 180 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0
TAG 160 181 181	0,7	2,4	0,8	0,7	0,9	0,8	1,0	0,5	3,4	5,1	2,5	4,7	12,5	1,7	0,2	0,4	1,3	0,8	2,0	1,1
TAG 160 181 182	2,6	1,9	3,4	2,6	2,7	3,2	2,3	2,0	4,8	2,8	3,7	8,4	3,0	4,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 181 183	1,3	1,8	0,0	1,3	1,8	1,5	0,0	3,1	6,6	5,1	6,1	1,0	3,4	9,8	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 181 205	1,5	1,3	1,2	1,5	1,2	2,0	2,2	1,3	0,0	0,0	0,0	0,0	0,0	0,0	4,9	8,1	3,0	0,0	0,0	0,0
TAG 160 181 225	0,7	0,4	0,7	0,7	0,4	0,7	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 182 182	4,1	4,9	4,3	4,1	2,9	3,2	2,1	4,1	1,8	1,6	0,0	1,9	0,0	5,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 182 183	2,4	2,5	3,1	2,4	2,6	2,3	1,5	9,2	5,8	3,7	3,5	0,5	0,4	15,4	0,0	0,0	0,0	0,0	0,0	0,0

TAG 160 182 205	4,3	3,3	3,1	4,3	1,7	3,8	2,4	7,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 182 225	1,7	1,6	2,1	1,7	0,8	1,4	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 183 183	0,3	0,3	0,5	0,3	0,6	0,4	0,4	4,6	1,1	1,2	0,0	0,0	0,0	10,2	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 183 205	0,7	0,4	0,5	0,7	0,6	0,6	0,7	2,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 160 184 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,7	2,9	2,0	0,0	0,0	0,0
TAG 160 205 205	0,4	0,2	0,2	0,4	0,3	0,4	0,3	1,6	0,0	0,0	0,0	0,0	0,0	0,0	2,8	3,6	0,9	0,0	8,0	0,0
TAG 160 205 225	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,1	0,0
TAG 160 205 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	2,4	3,8	0,0	0,0	13,4	0,0
TAG 160 225 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	13,0	1,2	16,5
TAG 160 226 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	1,1	0,0	21,2	12,0	20,1
TAG 161 161 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,3	0,0	0,0	0,0	0,0
TAG 161 161 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,9	3,4	0,0	0,0	0,0	0,0
TAG 161 181 181	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,2	0,1	0,7	0,6	0,0	0,1	0,2	0,7	0,0	0,0	0,0

TAG 161 181 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 161 181 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	3,1	0,0	0,0	0,0	0,0
TAG 161 182 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,3	0,0	0,0	0,0	0,0	0,0	0,0
TAG 161 205 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,6	1,7	0,0	0,0	0,0	0,0
TAG 161 205 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,1	0,0	0,0	0,0	0,0	0,0
TAG 161 226 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,3	0,0	0,6	0,1	0,5
TAG 180 180 180	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 180 181	0,1	0,1	0,1	0,1	0,2	0,1	0,1	0,4	0,2	0,2	0,1	0,3	0,7	0,2	0,0	0,0	0,0	0,1	0,1	0,1
TAG 180 180 182	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,5	0,0	0,0	0,1	0,0	0,1	0,3	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 180 183	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 181 181	0,2	0,3	0,2	0,2	0,3	0,2	0,2	0,2	0,8	0,6	0,3	1,4	2,8	0,0	0,0	0,0	0,0	0,4	0,6	0,4
TAG 180 181 182	0,5	0,8	0,4	0,5	0,6	0,5	0,4	0,8	0,7	0,9	0,9	1,3	1,7	0,0	0,0	0,0	0,0	0,0	0,2	0,0
TAG 180 181 183	0,9	0,4	0,4	0,9	0,8	0,4	0,4	1,4	2,0	0,9	0,9	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0

TAG 180 181 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 181 205	0,8	0,4	0,4	0,8	0,4	0,9	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0
TAG 180 181 225	0,2	0,1	0,1	0,2	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,2	0,0	0,0	0,0	0,0
TAG 180 182 182	0,9	0,8	1,0	0,9	0,9	0,8	0,6	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 182 183	0,8	0,6	0,8	0,8	0,7	0,7	0,6	5,0	0,6	0,5	0,6	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 182 205	0,7	0,4	0,4	0,7	0,6	0,7	0,7	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 182 225	0,6	0,3	0,5	0,6	0,3	0,9	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 183 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,6	0,3	0,3	0,0	0,0	0,0	1,4	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 183 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 180 205 205	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,7	0,0	0,0	0,0	0,0
TAG 180 205 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,9	0,0	0,0	0,7	0,0
TAG 180 226 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,2	0,0	0,5	0,4	0,4
TAG 181 181 181	1,2	1,4	1,1	1,2	2,9	1,3	2,6	0,5	12,4	8,2	0,0	20,9	29,9	0,3	0,1	0,2	0,3	3,3	5,0	3,3

TAG 181 181 182	2,1	3,8	4,6	2,1	3,7	3,5	2,6	0,5	10,8	9,1	17,1	33,1	18,8	1,7	0,0	0,0	0,0	0,7	1,1	0,4
TAG 181 181 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	23,1	18,4	6,2	13,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 181 203	0,6	0,0	0,5	0,6	0,7	1,0	1,1	0,0	0,0	0,0	4,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 181 204	1,5	0,0	0,0	1,5	1,7	0,0	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 181 205	5,3	6,6	7,5	5,3	6,9	4,9	7,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	1,3	0,0	0,0	0,0	0,0
TAG 181 181 225	1,9	2,5	1,5	1,9	1,0	1,4	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,0	0,0	0,0
TAG 181 181 226	0,5	0,7	0,3	0,5	1,0	0,8	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,8	0,0	0,0	0,0	0,0
TAG 181 182 182	5,2	8,0	9,9	5,2	8,1	6,1	4,9	0,0	13,5	5,5	5,0	13,1	4,9	0,0	0,0	0,0	0,0	0,5	0,6	0,3
TAG 181 182 183	5,7	5,8	4,6	5,7	6,5	5,8	6,0	3,1	16,4	18,6	13,3	3,6	3,8	8,7	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 182 203	0,9	1,6	1,6	0,9	1,3	2,0	1,6	0,0	0,0	0,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 182 205	10,1	10,2	10,5	10,1	7,5	12,4	10,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 182 225	4,2	3,0	3,8	4,2	2,7	3,5	3,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 182 226	1,4	0,9	0,8	1,4	1,2	2,1	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

TAG 181 183 183	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,9	8,0	4,1	4,5	0,0	1,3	4,4	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 183 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 204 205	1,2	0,0	0,0	1,2	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 181 205 205	1,1	0,8	1,0	1,1	1,2	1,8	1,3	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,8	1,2	0,3	0,0	0,0	0,0
TAG 181 205 225	0,6	0,4	0,4	0,6	0,5	0,8	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,3	0,0	0,0	0,0	0,0
TAG 181 205 226	0,4	0,3	0,1	0,4	0,1	0,2	0,2	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,9	1,6	0,0	0,0	0,0	0,0
TAG 181 226 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,3	0,0	0,0	0,0	0,0
TAG 182 182 182	4,2	6,4	5,5	4,2	3,0	3,5	6,0	0,8	2,4	1,7	0,0	1,6	0,3	2,0	0,0	0,0	0,0	0,3	0,5	0,6
TAG 182 182 183	3,3	3,5	5,7	3,3	5,3	3,4	3,9	1,9	2,9	2,7	3,4	0,3	0,4	8,4	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 182 203	1,0	0,0	0,0	1,0	0,8	0,0	1,9	0,0	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 182 205	5,3	8,1	3,6	5,3	7,3	5,1	6,9	2,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 182 225	2,6	2,1	2,5	2,6	2,1	2,6	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 182 226	1,2	1,1	0,6	1,2	1,5	1,2	1,4	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

TAG 182 183 183	1,5	1,0	1,5	1,5	2,3	1,4	1,1	2,8	2,0	2,1	2,0	0,0	0,2	7,5	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 183 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,6	0,0	0,0	2,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 183 205	2,7	2,0	2,8	2,7	2,7	3,4	3,5	4,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 183 225	1,6	1,0	1,3	1,6	0,7	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 183 226	0,9	0,0	0,0	0,9	1,1	0,0	0,8	2,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 205 205	0,9	0,5	0,6	0,9	0,7	1,1	1,7	2,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 205 225	1,1	0,5	0,4	1,1	0,5	1,1	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 205 226	0,0	0,3	0,2	0,0	0,0	0,4	0,0	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 182 225 226	0,2	0,1	0,1	0,2	0,1	0,2	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 183 183 183	0,1	0,0	0,2	0,1	0,3	0,2	0,1	0,7	0,6	0,5	0,0	0,0	0,0	1,3	0,0	0,0	0,0	0,0	0,0	0,0
TAG 183 183 203	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 183 183 205	0,4	0,2	0,4	0,4	0,3	0,5	0,4	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 183 183 226	0,1	0,1	0,1	0,1	0,1	0,1	0,1	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

TAG 183 205 205	0,4	0,1	0,2	0,4	0,3	0,5	0,3	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,4	0,0	0,0	0,0	0,0
TAG 183 205 226	0,0	0,1	0,1	0,0	0,0	0,2	0,0	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TAG 205 205 205	0,2	0,1	0,1	0,2	0,1	0,2	0,1	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,9	0,4	0,0	2,5	0,0
TAG 205 205 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,8	0,2	0,5	5,1	0,8
TAG 205 226 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,5	0,0	1,0	5,3	1,5
TAG 226 226 226	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	4,7	3,8	7,7

Sequences of the invention

Table 193 shows the sequences of the invention by their name, and the associated SEQ-ID number of the sequence lisiting. Further sequences of the present invention are included in the sequence listing.

Table 193: Association of sequence names to SEQ-IDs in the sequence listing.

			Continued from column 1 and 2	
SEQ ID NO:	**Sequence Name**		**SEQ ID NO:**	**Sequence Name**
1	RTP10690-1qcz_F		129	j-i-Atss1_c-d5Elo(Ot_GA3)_P
2	RTP10691-2qcz		130	j-i-Atss1_c-d6Elo(Tp_GA2)_P
3	VC-LTM593-1qcz		131	j-i-Atss14_c-d12Des(Ps_GA)_P
4	VC-LTM595-1qcz		132	j-i-Atss18_c-d6Elo(Pp_GA2)_P
5	VC-LJB2197-1qcz		133	j-i-Atss18_c-o3Des(Pi_GA2)_P
6	VC-LJB2755-2qcz		134	j-i-Atss2_c-d4Des(Tc_GA3)_P
7	VC-LLM306-1qcz		135	j-i-Atss2_c-d6Des(Ot febit_GA)_P
8	VC-LLM337-1qcz		136	j-p-BnFAE_ t-PvARC_P
9	VC-LLM338-3qcz		137	j-p-BnSETL-v1_c-o3Des(Pir_GA)_P
10	VC-LLM391-2qcz		138	j-p-LuPXR_i-Atss15_P
11	VC-LLM217-1qcz		139	j-p-PvARC5_t-BnFAE_P
12	o3DES-594FAM		140	j-p-PvARC5_t-BnSETL_P
13	o3DESPIR-198FAM		141	j-t-CaMV_p-LuCnl-2_P
14	o3DESPIR-962FAM		142	j-t-E9-p3-2_P
15	AtPXR-Fam		143	j-t-PvARC-p-LuCnl_P
16	BnSETL-1186FAM		144	j-t-StCAT_p2_p-LuPXR_P
17	BnSETL-Fam		145	reference (Adh1)_P
18	E011		146	c-o3Des(Pi_GA2_SNP)_F
19	D4DES-Tc-FAM		147	j-t-PvARC-p3_F
20	D4DES-Eg-FAM		148	j-i-Atss15_c-o3Des(Pi_GA2)_F
21	D4DES-PI-770FAM		149	j-p-VfSBPperm3_c-o3Des(Pir_GA)_F
22	Exp3-78-YAK		150	c-d15Des(Ch_ERTp_GA)_F
23	o3DES-572F		151	j-i-Atss2_c-d4Des(Pl_GA)-195R)_F
24	o3DESPIR-160F		152	c-o3Des(Pi_GA2_SNP)_R
25	o3DESPIR-924F		153	j-t-PvARC-p3_R
26	o3DesPir-F		154	j-i-Atss15_c-o3Des(Pi_GA2)_R
27	BnSETL-1164-F		155	j-p-VfSBPperm3_c-o3Des(Pir_GA)_R
28	MA54		156	c-d15Des(Ch_ERTp_GA)_R
29	D4DES-Tc-F		157	j-i-Atss2_c-d4Des(Pl_GA)-195R)_R
30	D4DES-EG-F		158	c-o3Des(Pi_GA2_SNP)_P
31	D4DES-PI-746-F		159	j-t-PvARC-p3_P
32	Exp 3-52F		160	j-i-Atss15_c-o3Des(Pi_GA2)_P
33	o3DES-652R		161	j-p-VfSBPperm3_c-o3Des(Pir_GA)_P
34	o3DESPIR-262R		162	c-d15Des(Ch_ERTp_GA)_P
35	o3DESPIR-1026-R		163	j-i-Atss2_c-d4Des(Pl_GA)-195R)_P
36	AtPXR-R		164	LANBCH locus 1 (N5) Forward primer
37	o3DESPIR-R		165	LANBCH locus 1 (N9) Forward primer
38	MA55		166	LANBCH locus 2 (N5) Forward primer
39	D4DES-Tc-988R		167	LANBCH locus 2 (N9) Forward primer
40	D4DES-Eg-R		168	LBFDAU locus 1 Forward primer
41	D4DES-PI-817R		169	LBFDAU locus 2 Forward primer
42	Exp 3-128R		170	LBFDGG Forward primer
43	RTP10690_1		171	LBFDHG locus 1 Forward primer
44	RTP10690_2		172	LBFDHG locus 2 Forward primer
45	RTP10690_3		173	LBFGKN Forward primer
46	RTP10690_4		174	LBFIHE Forward primer
47	RTP10690_5		175	LBFLFK locus 1 Forward primer
48	RTP10690_6		176	LBFLFK locus 2 Forward primer
49	RTP10690_7		177	LBFPRA Locus 1 Forward primer

			Continued from column 1 and 2	
SEQ ID NO:	Sequence Name		SEQ ID NO:	Sequence Name
50	RTP10690_8		178	LBFPRA locus 2 Forward primer
51	RTP10690_9		179	LBFPRA Locus 3e Forward primer
52	RTP10690_10		180	LANBCH locus 1 (N5) Reverse primer
53	RTP10690_11		181	LANBCH locus 1 (N9) Reverse primer
54	RTP10690_12		182	LANBCH locus 2 (N5) Reverse primer
55	RTP10690_5'		183	LANBCH locus 2 (N9) Reverse primer
56	t-AtAHASL		184	LBFDAU locus 1 Reverse primer
57	LJB2197_5'		185	LBFDAU locus 2 Reverse primer
58	LJB2197_1		186	LBFDGG Reverse primer
59	LJB2197_2		187	LBFDHG locus 1 Reverse primer
60	LJB2197_3		188	LBFDHG locus 2 Reverse primer
61	LJB2197_4		189	LBFGKN Reverse primer
62	c-AHAS_F		190	LBFIHE Reverse primer
63	c-d4Des(Eg_GA)_F		191	LBFLFK locus 1 Reverse primer
64	c-d4Des(Pl_GA)2_F		192	LBFLFK locus 2 Reverse primer
65	c-d4Des(Tc_GA)_F		193	LBFPRA Locus 1 Reverse primer
66	c-d5Des(Tc_GA)_F		194	LBFPRA locus 2 Reverse primer
67	c-d5Elo(Ot_GA3)_F		195	LBFPRA Locus 3e Reverse primer
68	c-d6Des(Ot_febit)_F		196	LANBCH locus 1 (N5) Probe sequence
69	c-d6Elo(Pp_GA)_F		197	LANBCH locus 1 (N9) Probe sequence
70	c-d6Elo(Tp_GA)_F		198	LANBCH locus 2 (N5) Probe sequence
71	c-o3Des(Pi_GA)_F		199	LANBCH locus 2 (N9) Probe sequence
72	c-o3Des(Pir_GA)_F		200	LBFDAU locus 1 Probe sequence
73	j-i-Atss1_c-d5Elo(Ot_GA3)_F		201	LBFDAU locus 2 Probe sequence
74	j-i-Atss1_c-d6Elo(Tp_GA2)_F		202	LBFDGG Probe sequence
75	j-i-Atss14_c-d12Des(Ps_GA)_F		203	LBFDHG locus 1 Probe sequence
76	j-i-Atss18_c-d6Elo(Pp_GA2)_F		204	LBFDHG locus 2 Probe sequence
77	j-i-Atss18_c-o3Des(Pi_GA2)_F		205	LBFGKN Probe sequence
78	j-i-Atss2_c-d4Des(Tc_GA3)_F		206	LBFIHE Probe sequence
79	j-i-Atss2_c-d6Des(Ot febit_GA)_F		207	LBFLFK locus 1 Probe sequence
80	j-p-BnFAE_ t-PvARC_F		208	LBFLFK locus 2 Probe sequence
81	j-p-BnSETL-v1_c-o3Des(Pir_GA)_F		209	LBFPRA Locus 1 Probe sequence
82	j-p-LuPXR_i-Atss15_F		210	LBFPRA locus 2 Probe sequence
83	j-p-PvARC5_t-BnFAE_F		211	LBFPRA Locus 3e Probe sequence
84	j-p-PvARC5_t-BnSETL_F		212	VC-LJB2197-1qcz LANBCH RB6 Locus 1
85	j-t-CaMV_p-LuCnl-2_F		213	VC-LJB2197-1qcz LANBCH LB2 Locus 1
86	j-t-E9-p3-2_F		214	VC-LLM337-1qcz LANBCH RB2 Locus 1
87	j-t-PvARC-p-LuCnl_F		215	VC-LLM337-1qcz LANBCH LB1 Locus 1
88	j-t-StCAT_p2_p-LuPXR_F		216	VC-LJB2197-1qcz LANBCH RB3 Locus 2
89	reference (Adh1)_F		217	VC-LLM337-1qcz LANBCH RB1 Locus 2
90	c-AHAS_R		218	VC-LTM593-1qcz LBFDGG RB
91	c-d4Des(Eg_GA)_R		219	VC-LTM593-1qcz LBFDGG LB
92	c-d4Des(Pl_GA)2_R		220	VC-LTM593-1qcz LBFDHG RB Locus 1
93	c-d4Des(Tc_GA)_R		221	VC-LTM593-1qcz LBFDHG LB Locus 1
94	c-d5Des(Tc_GA)_R		222	VC-LTM593-1qcz LBFDHG RB Locus 2
95	c-d5Elo(Ot_GA3)_R		223	VC-LTM593-1qcz LBFDHG LB Locus 2
96	c-d6Des(Ot_febit)_R		224	VC-LTM593-1qcz LBFGKN RB1
97	c-d6Elo(Pp_GA)_R		225	VC-LTM593-1qcz LBFGKN LB1
98	c-d6Elo(Tp_GA)_R		226	VC-LTM593-1qcz LBFIHE RB1
99	c-o3Des(Pi_GA)_R		227	VC-LTM593-1qcz LBFIHE LB1
100	c-o3Des(Pir_GA)_R		228	VC-LTM593-1qcz LBFLFK RB1 Locus 1
101	j-i-Atss1_c-d5Elo(Ot_GA3)_R		229	VC-LTM593-1qcz LBFLFK LB1 Locus 1
102	j-i-Atss1_c-d6Elo(Tp_GA2)_R		230	VC-LTM593-1qcz LBFLFK RB2 Locus 2
103	j-i-Atss14_c-d12Des(Ps_GA)_R		231	VC-LTM593-1qcz LBFLFK LB2 Locus 2

			Continued from column 1 and 2	
SEQ ID NO:	Sequence Name		SEQ ID NO:	Sequence Name
104	j-i-Atss18_c-d6Elo(Pp_GA2)_R		232	VC-LTM593-1qcz LBFPRA RB1 Locus 1
105	j-i-Atss18_c-o3Des(Pi_GA2)_R		233	VC-LTM593-1qcz LBFPRA LB1 Locus 1
106	j-i-Atss2_c-d4Des(Tc_GA3)_R		234	VC-LTM593-1qcz LBFPRA RB3 Locus 2
107	j-i-Atss2_c-d6Des(Ot febit_GA)_R		235	VC-LTM593-1qcz LBFPRA L1 Locus 2
108	j-p-BnFAE_ t-PvARC_R		236	VC-LTM593-1qcz LBFPRA Locus 3e
109	j-p-BnSETL-v1_c-o3Des(Pir_GA)_R		237	VC-LTM593-1qcz LBFDAU RB1 Locus 1
110	j-p-LuPXR_i-Atss15_R		238	VC-LTM593-1qcz LBFDAU LB1 Locus 1
111	j-p-PvARC5_t-BnFAE_R		239	VC-LTM593-1qcz LBFDAU R Locus 2
112	j-p-PvARC5_t-BnSETL_R		240	VC-LTM593-1qcz LBFDAU L Locus 2
113	j-t-CaMV_p-LuCnl-2_R		241	Amplicon LANBCH locus 1 (N5)
114	j-t-E9-p3-2_R		242	Amplicon LANBCH locus 1 (N9)
115	j-t-PvARC-p-LuCnl_R		243	Amplicon LANBCH locus 2 (N5)
116	j-t-StCAT_p2_p-LuPXR_R		244	Amplicon LANBCH locus 2 (N9)
117	reference (Adh1)_R		245	Amplicon LBFDAU locus 1
118	c-AHAS_P		246	Amplicon LBFDAU locus 2
119	c-d4Des(Eg_GA)_P		247	Amplicon LBFDGG
120	c-d4Des(Pl_GA)2_P		248	Amplicon LBFDHG locus 1
121	c-d4Des(Tc_GA)_P		249	Amplicon LBFDHG locus 2
122	c-d5Des(Tc_GA)_P		250	Amplicon LBFGKN
123	c-d5Elo(Ot_GA3)_P		251	Amplicon LBFIHE
124	c-d6Des(Ot_febit)_P		252	Amplicon LBFLFK locus 1
125	c-d6Elo(Pp_GA)_P		253	Amplicon LBFLFK locus 2
126	c-d6Elo(Tp_GA)_P		254	Amplicon LBFPRA Locus 1
127	c-o3Des(Pi_GA)_P		255	Amplicon LBFPRA locus 2
128	c-o3Des(Pir_GA)_P		256	Amplicon LBFPRA Locus 3e

Reference List

Arondel,V., Lemieux,B., Hwang,I., Gibson,S., Goodman,H.M., and Somerville,C.R. (1992). Map-based cloning of a gene controlling omega-3 fatty acid desaturation in Arabidopsis. Science *258*, 1353-1355.

Bafor, M., Smith, M. A., Jonsson, L., Stobart, K., and Stymne, S. Biochem J. (1991). Ricinoleic acid biosynthesis and triacylglycerol assembly in microsomal preparations from developing castor-bean (Ricinus communis) endosperm. 280, 507-514.

Bernert, J.T and Sprecher, H. (1977). Analysis of Partial Reactions in the Overall Chain Elongation of Saturated and Unsaturated Fatty Acids by Rat Liver Microsomes. J. Biol. Chem. *252*, 6736-6744.

Banas, A., Bafor, M., Wiberg, E., Lenman, M., Ståhl, U., Stymne, S. (1997). Biosynthesis of an Acetylenic Fatty Acid in Microsomal Preparations from Developing Seeds of *Crepis alpina*. In: *Physiology, Biochemistry and Molecular Biology of Plant Lipids* (Williams, J. P., Kahn, M. U., Lem, N. W., eds.) pp. 57-59. Kluwer Academic Press, Dordrecht.

Bates PD, Fatihi A, Snapp AR, Carlsson AS, Browse J, Lu C (2012) Acyl Editing and Headgroup Exchange Are the Major Mechanisms That Direct Polyunsaturated Fatty Acid Flux into Triacylglycerols. Plant Physiology 160: 1530-1539

Bligh, E. G., and Dyer, J. J. (1959). A rapid method for total lipid extraction and purification. Can J. Biochem. Physiol. *37*: 911-918

Broadwater,J.A., Whittle,E., and Shanklin,J. (2002). Desaturation and hydroxylation. Residues 148 and 324 of Arabidopsis FAD2, in addition to substrate chain length, exert a major influence in partitioning of catalytic specificity. J. Biol. Chem. *277*, 15613-15620.
Broun,P., Shanklin,J., Whittle,E., and Somerville,C. (1998b). Catalytic plasticity of fatty acid modification enzymes underlying chemical diversity of plant lipids. Science *282*, 1315-1317.
Calvo,A.M., Gardner,H.W., and Keller,N.P. (2001). Genetic connection between fatty acid metabolism and sporulation in *Aspergillus nidulans*. J. Biol. Chem. *276*, 25766-25774.
Brown AJ., Sweeney B., Mainwaring DO. and James DC. (2014) Synthetic Promoters for CHO Cell Engineering. Biotechnology and Bioengineering, 111, 8:1638-1647.
Cutler SR., Rodriguez PL., Finkelstein RR., and Abrams SR. (2010) Abscisic Acid: Emergence of a Core Signaling Network. Annual Review of Plant Biology 61:651–679.
Demekes T. and Jenkins RG. (2010) Influence of DNA extraction methods, PCR inhibitors and quantification methods on real-time PCR assay of biotechnology-derived traits. Analytical and Bioanalytical Chemistry 396, 1977–1990.
Domergue, F. Abbadi, A., Ott, C., Zank, T. K., Zahringer, U., and Heinz, E. (2003) Acyl Carriers Used as Substrates by the Desaturases and Elongases Involved in Very Long-chain Polyunsaturated Fatty Acids Biosynthesis Reconstituted in Yeast. J. Biol. Chem. *278*, 35115-35126
Domergue, F., Abbadi, A., Zähringer, U., Moreau, H., Heinz, E. (2005) In vivo characterization of the first acyl-CoA D6-desaturase from a member of the plant kingdom, the microalga *Ostreococcus tauri.* Biochem. J. *389*, 483-490.
Dubos C., Kelemen Z., Sebastian A., Bülow L., Huep G., Xu W., Grain D., Salsac F., Brousse C., Lepiniec L, Weisshaar B., Contreras-Moreira B. and Hehl R. BMC Genomics 15:317.
Focks N. and Benning C. (1998) wrinkled1: A novel, low-seed-oil mutant of Arabidopsis with a deficiency in the seed-specific regulation of carbohydrate metabolism. Plant Physiology 118, 1:91-101.
Ganas et al in Physiology, Biochemistry and Molecular Biology of Plant Lipids, Eds Williams, J.P., Khan, M.U. and Lem, N.W., Kluwer Academic Publishers, NL, 1996, 57-59
Griffiths, G., Stobart, A. K., and Stymne, S. (1988). Δ6- and Δ12-desaturase activities and phosphatidic acid formation in microsomal preparations from the developing cotyledons of common borage (*Borago officinalis*). Biochem. J. *252*, 641-647
Hamilton CM (1997) A binary-BAC system for plant transformation with high-molecular-weight DNA. Gene 200: 107–116
Hattori T., Totsuka M., Hobo T., Kagaya Y., Yamamota-Toyoda A. (2002) Experimentally determined sequence requirement of ACGT containing abscisic acid response element. Plant and Cell Physiology 43, 1:136-140.
Higo K., Ugawa Y., Iwamoto M., Korenaga T. (1999) Plant Cis-acting regulatory DNA elements (PLACE) database: 1999. Nucleic Acids Research 27, 1:297-300.
Hinnebusch A. (2014) The Scanning Mechanism of Eukaryotic Translation Initiation. Annual Review of Biochemistry 83, 779–812
Jain, S., Stanford, N., Bhagwat, N., Seiler, B., Costanzo, M., Boone, C. and Peter, P. (2007). Identification of a Novel Lysophospholipid Acyltransferase in *Saccaromyces cerevisiae*. J. Biol. Chem. 282, 30562-30569.

Kargiotidou A., Deli D., Galanopoulou D., Tsaftaris A. and Farmaki T. (2008) Low temperature and light regulate delta 12 fatty acid desaturases (FAD2) at a transcriptional level in cotton (*Gossypium hirsutum*) Journal of Experimental Botany, 59, 8:2043–2056
Keller W., Konig P. and Richmond TJ. (1995) Crystal Structure of a bZIP/DNA Complex at 2.2 Å: Determinants of DNA Specific Recognition. Journal of Molecular Biology 254, 657–667.
Kim W-C., Reca I-B., Kim YS. Park S., Thomashow MF. Keegstra K. Han K-H. (2014) Transcription factors that directly regulate the expression of CSLA9 encoding mannan synthase in Arabidopsis thaliana. Plant Molecular Biology 84, 577–587
Knutzon,D.S., Thurmond,J.M., Huang,Y.S., Chaudhary,S., Bobik,*E.G.*, Jr., Chan,G.M., Kirchner,S.J., and Mukerji,P. (1998). Identification of Delta5-dehydratase from Mortierella alpina by heterologous expression in Bakers' yeast and canola. J. Biol. Chem. *273*, 29360-29366.
Komori, T., Imayama, T., Kato, N., Ishida, N., Ueki, j., and Komari, T. (2007). Current Status of Binary Vectors and Superbinary Vectors. Plant Physiology *145(4)*, 1155-1160, doi: http://dx.doi.org/10.1104/pp.107.105734
Kong F., Yamasaki T. and Ohama T. (2014) Expression levels of domestic cDNA cassettes integrated in the nuclear genomes of various *Chlamydomonas reinhardtii* strains. Journal of Bioscience and Bioengineering 117, 5:613-616.
Kozak M. Initiation of translation in prokaryotes and eukaryotes (1999) Gene 234, 187-208.
Livak K. and Schmittgen TD. (2001) Analysis of Relative Gene Expression Data Using Real-Time Quantitative PCR and the 2-deltadeltaCT Method. Methods 25, 402–408.
López Y., Patil A., Nakai K. (2013) Identification of novel motif patterns to decipher the promoter architecture of co-expressed genes in *Arabidopsis thaliana*. BMC Systems Biology 7(Suppl 3):S10
Lowenthal, M., Liang, Y., Phinney, K.W., and Stein, S.E. (2014) Quantitative Bottom-Up Proteomics Depends on Digestion Conditions. Anal Chem. 86:551-558
Machens F., Becker M., Umrath F., Hehl R. (2014) Identification of a novel type of WRKY transcription factor binding site in elicitor-responsive cis-sequences from *Arabidopsis thaliana*. Plant Molecular Biology 84,371–385
Mantle,P.G. and Nisbet,L.J. (1976). Differentiation of Claviceps purpurea in axenic culture. J. Gen. Microbiol. *93*, 321-334.
Makriyannis T, Clonis YD. (1997) Design and study of peptide-ligand affinity chromatography adsorbents: application to the case of trypsin purification from bovine pancreas. Biotech Bioeng.; 53: 49-57.
Meggendorfer M., Weierich C., Wolff H., Brack-Werner R., Cremer T. (2010) Functional nuclear topography of transcriptionally inducible extra-chromosomal transgene clusters. Chromosome Research 18, 401–417.
Meesapyodsuk, D., Qui, X. (2012). The Front-end Desaturase: Structure, Function, Evolution and Biotechnological Use Lipids *47*, 227-237
Mendel, J.G. (1866). *Versuche über Pflanzenhybriden* Verhandlungen des naturforschenden Vereines in Brünn, Bd. IV für das Jahr, 1865 Abhandlungen:3–47.
Mey,G., Oeser,B., Lebrun,M.H., and Tudzynski,P. (2002). The biotrophic, non-appressorium-forming grass pathogen Claviceps purpurea needs a Fus3/Pmk1 homologous mitogen-activated protein kinase for colonization of rye ovarian tissue. Mol. Plant Microbe Interact. *15*, 303-312.

Muino JM., Smaczniak C., Angenent GC., Kaufmann K. and van Dijk ADJ. (2014) Structural determinants of DNA recognition by plant MADS-domain transcription factors. Nucleic Acids Research 42,4:2138-2146.
Murashige T. and Skoog F. (1962) A Revised Medium for Rapid Growth and Bio Assays with Tobacco Tissue Cultures. Physiologia Plantarum 15, 3:473-497
Nakagawa S., Niimura Y., Gojobori T., Tanaka H., and Miura K-I. (2008) Diversity of preferred nucleotide sequences around the translation initiation codon in eukaryote genomes. Nucleic Acids Research 36, 3:861–871
Nishikata K., Cox RS III., Shimoyama S., Yoshida Y., Matsui M., Makita Y. and Toyoda T. (2013) Database Construction for PromoterCAD: Synthetic Promoter Design for Mammals and Plants ACS Synthetic Biology 3, 192−196.
Okayasu, T.; Nagao, M.; Ishibashi, T.; and Imai, Y. (1981) Purification and Parial Characterization of Linoleoyl-CoA Desaturase from Rat Liver Microsomes Arch. Biochem. Biophys. 206, 21-28.
Okuley,J., Lightner,J., Feldmann,K., Yadav,N., Lark,E., and Browse,J. (1994). Arabidopsis FAD2 gene encodes the enzyme that was essential for polyunsaturated lipid synthesis. Plant Cell *6*, 147-158.
Parker S.C.J., Hansen L., Abaan H.O, Tullius T.D., Margulies E.H. (2009) Local DNA Topography Correlates with Functional Noncoding Regions of the Human Genome. Science 324, 389-392.
Paul, S., Gable, K., Beaudoin, F., Cahoon, E. Jaworski, J., Napier, J. A., and Dunn, T. M. (2006). Members of the Arabidopsis FAE1-like 3-Ketoacyl-CoA Synthase Gene Family Substitute for the Elop Proteins of *Saccharomyces cerevisiae*. J. Biol. Chem. *281*, 9018-9029.
Proc, J.L., Kuzyk, M.A., Hardie, D.B., Yang, J., Smith, D.S., Jackson, A.M. Parker, C.E., and Borchers, C.H. (2010) A quantitative study of the effects of chaotropic agents, surfactants, and solvents on the digestion efficiency of human plasma proteins by trypsin. J. Proteome Res. 9, 5422–5437.
Qi,B., Fraser,T., Mugford,S., Dobson,G., Sayanova,O., Butler,J., Napier,J.A., Stobart,A.K., and Lazarus,C.M. (2004). Production of very long chain polyunsaturated omega-3 and omega-6 fatty acids in plants. Nat. Biotechnol. *22*, 739-745.
Ramamoorthy S., Garapati H.S., Mishra R.K. (2014) Length and sequence dependent accumulation of simple sequence repeats in vertebrates: Potential role in genome organization and regulation. Gene 551,167-175.
Riekhof, W. R., Wu, J., Gijón, M. A., Zarini, S., Murphy, R. C. and Voelker, D. R. Lysophosphatidylcholine Metabolism in *Saccaromyces cerevisiae*: The Role of P-Type ATPases In Transport and A Broad Specificity Acyltransferase in Acylation. J. Biol. Chem. *2007*, 282:36853-36861.
Ruiz-Lopez N., Haslam RP., Napier JA. and Sayanova O. (2014) Successful high-level accumulation of fish oil omega-3 long-chain polyunsaturated fatty acids in a transgenic oilseed crop. The Plant Journal 77, 198–208.
Ruuska SA., Girke T., Benning C., and John B. Ohlrogge. Contrapuntal Networks of Gene Expression during Arabidopsis Seed Filling The Plant Cell 14, 6:1191-1206.
Sánchez-García A. Mancha M., Heinz E., Martínez-Rivas J.M. (2004) Differential temperature regulation of three sunflower microsomal oleate desaturase (FAD2) isoforms overexpressed in *Saccharomyces cerevisiae* European Journal of Lipid Science and Technology 106, 583–590

Sarkar AK. and Lahiri A. (2013) Specificity determinants for the abscisic acid response element. FEBS Open Bio 3, 101–105.
Schwender J., Goffman F., Ohlrogge J.B., and Shachar-Hill Y (2004) Rubisco without the Calvin cycle improves the carbon efficiency of developing green seeds. Nature 432, 779-782
Shanklin J, Somerville C. (1991) Stearoyl-acyl-carrier-protein desaturase from higher plants was structurally unrelated to the animal and fungal homologs. Proc Natl Acad Sci USA *88*, 2510-2514.
Shanklin,J. and Cahoon,E.B. (1998). DESATURATION AND RELATED MODIFICATIONS OF FATTY ACIDS1. Annu. Rev. Plant Physiol Plant Mol. Biol. *49*, 611-641.
Smith, P. K., Krohn, R. I., Hermanson, G. T., Mallia, A. K., Gartner, F. H., Provenzano, M. D., Fujimoto, E. K., Goeke, N. M., Olson, B. J., and Klenk, D. C. (1985). Measurement of protein using bicinchonic acid. Anal. Biochem. *150*, 76–85.
Strittmatter, P.; Spatz, L.; Corcoran, D.; Rogers, M.J.; Setlow, B.; and Redline, R. (1974) Purification and properties of rat liver microsomal stearyl coenzyme A desaturase. Proc. Nat. Acad. Sci. USA *71*, 4565-4569.
Stymne, S. and Stobart, A. K. (1986) Biosynthesis of γ-linolenic acid in cotyledons and microsomal preparations of the developing seeds of common borage (*Borago officinalis*). Biochem. J. *240*, 385-393.
Tamaki, H., Shimada, A., Ito, Y.,Ohya, M., Takase, J., Miyashita, M., Miyagawa, H., Nozaki, H., Nakayama, R. and Hidehiko Kumagai (2007) *LPT1* Encodes a Membrane-bound O-Acyltransferase Involved in the Acylation of Lysophospholipids in the Yeast *Saccharomyces cerevisiae*. J. Biol. Chem. *282*, 34288-34298.
Tang G-Q., Novitzky WP., Griffin HC., Huber SC., and Dewey RE. (2005) Oleate desaturase enzymes of soybean: evidence of regulation through differential stability and phosphorylation. The Plant Journal 44, 433–446.
Tudzynski,P., Correia,T., and Keller,U. (2001). Biotechnology and genetics of ergot alkaloids. Appl. Microbiol. Biotechnol. *57*, 593-605.
Wachter E., Quante T., Merusi C., Arczewska A., Stewart F., Webb S., Bird A. (2014) Synthetic CpG islands reveal DNA sequence determinants of chromatin structure. eLIFE e03397. DOI: 10.7554/eLife.03397.
Wijesundra C. (2008) The influence of triacylglycerol structure on the oxidative stability of polyunsaturated oils. Lipid Technology 20,199-202.
Xiao G., Zhang ZQ., Yin CF., Liu RY., Wu XM., Tan TL., Chen SY., Lu CM. and Guan CY. (2014) Characterization of the promoter and 5′-UTR intron of oleic acid desaturase (FAD2) gene in *Brassica napus*. Gene 545, 45-55.

Claims

1. T-DNA for expression of a target gene in a plant, wherein the T-DNA comprises a left and a right border element and at least one expression cassette comprising a promoter, operatively linked thereto a target gene, and downstream thereof a terminator, wherein the length of the T-DNA, measured from left to right border element and comprising the target gene, has a length of at least 30000 bp.

2. T-DNA comprising the coding sequences of any single gene of the tables given in the examples, preferably comprising the coding sequences and and promoters of any single of the tables given in the examples, more preferably the coding sequences and promoters and terminators of any single of the tables given in the examples, and most preferably the expression cassettes of any single of the tables of the examples, in particular wherein the T-DNA comprises the coding sequences of the desaturases and elongases of Table 11 in the Examples.

3. Plant or a seed or part thereof, comprising, integrated in its genome, a heterologous T-DNA of the present invention.

4. Plant comprising one or more T-DNA comprising one or more expression cassettes encoding for one or more d5Des, one or more d6Elo, one or more d6Des, one or more o3Des, one or more d5Elo and one or more D4Des.

5. The plant of claim 3 or 4 comprising one or more T-DNAs encoding for at least two d6Des, at least two d6Elo and/or, at least two o3Des.

6. The plant any one of claims 3 to 5 on or a part thereof comprising a T-DNA encoding for at least one CoA-depenent d4Des and at least one phopho-lipid dependent d4Des.

7 The plant, seed or part thereof any one of claims 3 to 6 the plant, seed or part thereof further encoding for one or more d12Des.

8. Plant or seed thereof of family Brassicaceae, preferably of genus Brassica, with a genotype that confers a heritable phenotype of seed oil VLC-PUFA content, obtainable or obtained from progeny lines prepared by a method comprising the steps of
   i) crossing a plant of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, said plant comprising a T-DNA of any of claims 1 or 2 and/or part of such T-DNA, with a plant of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, said plant not comprising said T-DNA and/or part thereof, to yield a F1 hybrid,
   ii) selfing the F1 hybrid for at least one generation, and

iii) identifying the progeny of step (ii) comprising the T-DNA of the present invention capable of producing seed comprising VLC-PUFA such that the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 6%, preferably at least 7,5% (w/w) and/or the content of DHA is at least 0,8% (w/w), preferably 1,2% of the total seed fatty acid content at an oil content of 40% (w/w).

9. Method for creating a plant with a genotype that confers a heritable phenotype of seed oil VLC-PUFA content, obtainable or obtained from progeny lines prepared by a method comprising the steps of
   i) crossing a transgenic plant according to any of claims 3 or 4 with a plant not comprising a T-DNA according to any of claims 1 or 2 or part thereof, said latter plant being of family Brassicaceae, preferably of genus Brassica, most preferably of genus Brassica napus, Brassica oleracea, Brassica nigra or Brassica carinata, to yield a F1 hybrid,
   ii) selfing the F1 hybrid for at least one generation, and
   iii) identifying the progeny of step (ii) comprising the T-DNA of the present invention capable of producing seed comprising VLC-PUFA such that the content of all VLC-PUFA downstream of 18:1n-9 is at least 40% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w), or preferably the content of EPA is at least 6%, preferably at least 7,5% (w/w) and/or the content of DHA is at least 0,8% (w/w), prerferably 1.2% (w/w) of the total seed fatty acid content at an oil content of 40% (w/w).

10. The method of claim 9 o the plant of claim 8, wherein the T-DNA is homozygous

11. Method of plant oil production, comprising the steps of
   i) growing a plant according to any of claims 3 to 8 such as to obtain oil-containing seeds thereof,
   ii) harvesting said seeds, and
   iii) extracting oil from said seeds harvested in step ii), wherein the oil has a DHA content of at least 1% by weight based on the total lipid content and/or a EPA content of at least 8% by weight based on the total lipid content.

12. Plant oil comprising a polyunsaturated fatty acid obtainable or obtained by the method of claim 11.

13. Method for analysing desaturase reaction specificity, comprising the steps of
   i) providing, to a desaturase, a detectably labelled molecule comprising a fatty acid moiety and a headgroup,
   ii) allowing the desaturase to react on the labelled molecule, and
   iii) detecting desaturation products.

14. Method for analysing elongase reaction specificity, comprising the steps of
    i) providing, to an elongase, a detectably labelled elongation substrate and a molecule to be elongated,
    ii) allowing the elongase to elongate the molecule to be elongated using the labelled elongation substrate, and
    iii) detecting elongation products.

15. Method for optimization of a metabolic pathway, comprising the steps of
    i) providing enzymes of a metabolic pathway and one or more substrates to be used by the first enzyme or enzymes of the pathway,
    ii) reacting the enzymes and the substrates to produce products, which in turn are also exposed as potential substrates to the enzymes of the pathway, and
    iii) determining the accumulation of products.

16. Method for determining CoA-dependence of a target desaturase, comprising the steps of
    i) providing an elongase to produce a substrate for the target desaturase, and determining conversion efficiency of the target desaturase, and
    ii) providing a non-CoA dependent desaturase to produce the substrate for the target desaturase, and determining conversion efficiency of the target desaturase, and
    iii) comparing the target desaturase conversion efficiencies of step i) and ii).

17. Method for determining CoA-dependence of a target desaturase, comprising the steps of
    i) providing an elongase to elongate the products of the target desaturase, and determining conversion efficiency of the elongase,
    ii) providing the elongase to elongate the products of a comparison desaturase known to be non-CoA dependent, and determining conversion efficiency of the elongase,
    iii) comparing the elongase conversion efficiencies of step i) and ii).

18. A method for increasing the content of Mead acid (20:3n-9) in a plant relative to a control plant, comprising expressing in a plant at least one polynucleotide encoding a delta-6-desaturase, at least one polynucleotide encoding a delta-6-elongase, and at least one polynucleotide encoding a delta-5-desaturase.

19. The method according to claim 18, further comprising expression a delta-12-desaturase, omega-3-desaturase, a delta-5-elongase, and/or a delta-4-desaturase.

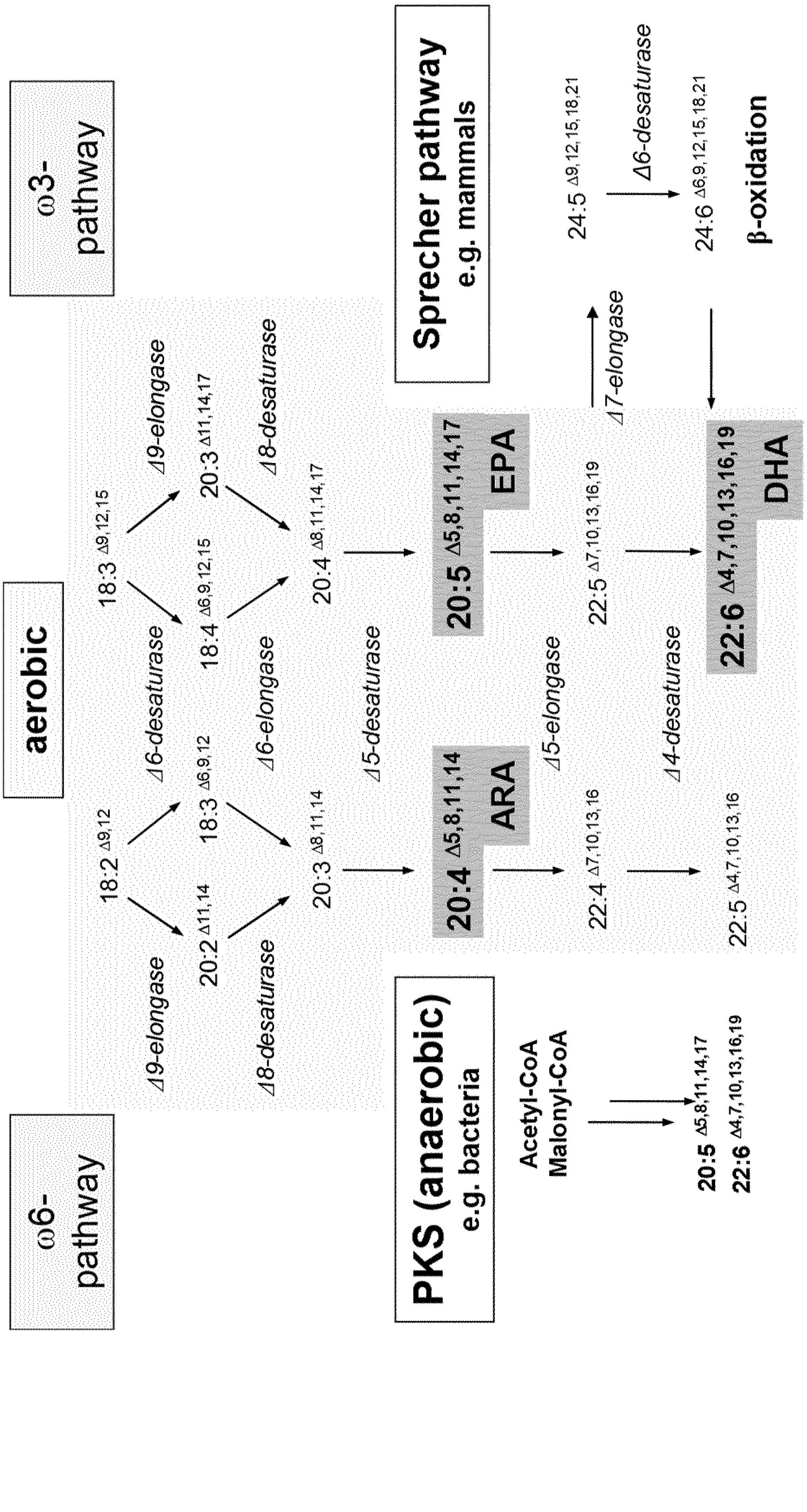

ω6-pathway
aerobic
ω3-pathway
18:2 Δ9,12
18:3 Δ9,12,15
Δ9-elongase
Δ6-desaturase
Δ9-elongase
20:2 Δ11,14
18:3 Δ6,9,12
18:4 Δ6,9,12,15
20:3 Δ11,14,17
Δ8-desaturase
Δ6-elongase
Δ8-desaturase
20:3 Δ8,11,14
20:4 Δ8,11,14,17
Δ5-desaturase
20:4 Δ5,8,11,14
ARA
20:5 Δ5,8,11,14,17
EPA
Δ5-elongase
22:4 Δ7,10,13,16
22:5 Δ7,10,13,16,19
Δ4-desaturase
22:5 Δ4,7,10,13,16
22:6 Δ4,7,10,13,16,19
DHA
Δ7-elongase
Sprecher pathway
e.g. mammals
24:5 Δ9,12,15,18,21
Δ6-desaturase
24:6 Δ6,9,12,15,18,21
β-oxidation
PKS (anaerobic)
e.g. bacteria
Acetyl-CoA
Malonyl-CoA
20:5 Δ5,8,11,14,17
22:6 Δ4,7,10,13,16,19

Fig. 1

Fig. 2

Formula used for pathway step conversion efficiency Ceff			$C_{eff} = \frac{100}{S + P} \times P$						
Pathway Step	**Product Stream**	**pre-requisite of product stream**							
d12Des	d12Des Product Stream 1	18:1n-9	18:1n-9	18:2n-6	18:3n-6	20:3n-6	20:4n-6	22:4n-6	22:5n-6
	d12Des Product Stream 2	18:3n-3 from 18:2n-6 via d15Des		18:3n-3	18:4n-3	20:4n-3	20:5n-3	22:5n-3	22:6n-3
	d12Des Product Stream 3	20:2n-6 from 18:2n-5 via d6Elo		20:2n-6					
	d12Des Product Stream 4	20:3n-3 from 18:3n-3 via d6Elo		20:3n-3					
d6Des	d12Des Product Stream 1	18:2n-6		18:2n-6	18:3n-6	20:3n-6	20:4n-6	22:4n-6	22:5n-6
	d12Des Product Stream 2	18:3n-3 produced by o3Des		18:3n-3	18:4n-3	20:4n-3	20:5n-3	22:5n-3	22:6n-3
d6Elo	d6Elo Product Stream 1	18:3n-6 produced by d6Des			18:3n-6	20:3n-6	20:4n-6	22:4n-6	22:5n-6
	d6Elo Product Stream 2	18:4n-3 produced by d6Des or o3Des			18:4n-3	20:4n-3	20:5n-3	22:5n-3	22:6n-3
d5Des	d5Des Product Stream 1	20:3n-6 produced by d6Elo				20:3n-6	20:4n-6	22:4n-6	22:5n-6
	d5Des Product Stream 2	20:4n-3 produced by d6Elo or o3Des				20:4n-3	20:5n-3	22:5n-3	22:6n-3
d5Elo	d5Elo Product Stream 1	20:4n-6 produced by d5Des					20:4n-6	22:4n-6	22:5n-6
	d5Elo Product Stream 2	20:4n-3 produced by d5Des or o3Des					20:5n-3	22:5n-3	22:6n-3
d4Des	d4Des Product Stream 1	20:4n-6 produced by d5Des						22:4n-6	22:5n-6
	d4Des Product Stream 2	20:4n-3 produced by d5Des or o3Des						22:5n-3	22:6n-3
o3Des	List of all o6Des Fatty acid substrates		18:2n-6	18:3n-6	20:2n-6	20:3n-6	20:4n-6	22:4n-6	22:5n-6
	List of all o3Des Fatty acid products		18:3n-3	18:4n-3	20:3n-3	20:4n-3	20:5n-3	22:5n-3	22:6n-3

Fig. 3

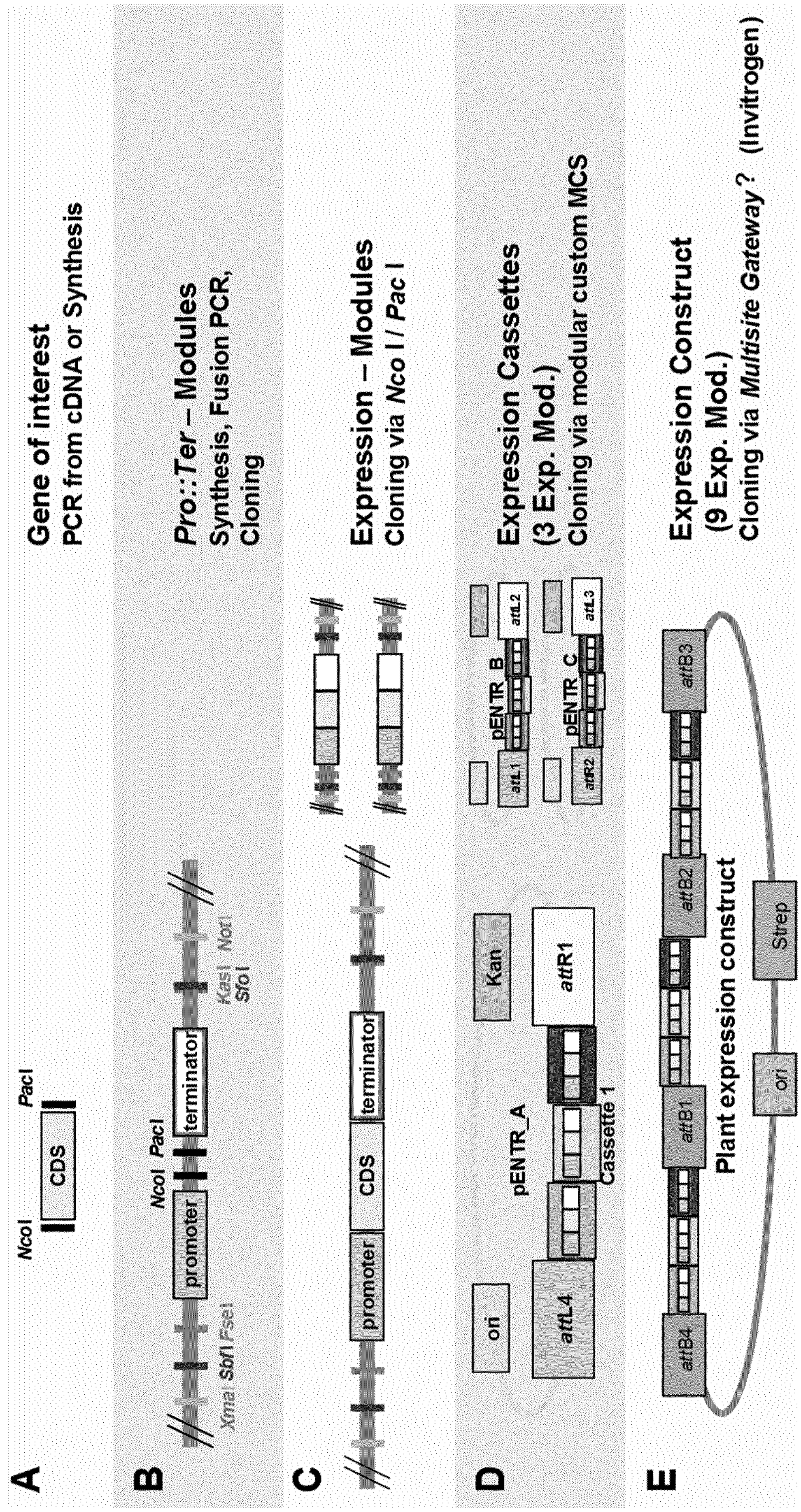

A
Gene of interest
PCR from cDNA or Synthesis
NcoI
CDS
PacI
B
Pro::Ter – Modules
Synthesis, Fusion PCR, Cloning
XmaI SbfI FseI
promoter
NcoI PacI
terminator
KasI SfoI
NotI
C
Expression – Modules
Cloning via Nco I / Pac I
promoter
CDS
terminator
D
Expression Cassettes
(3 Exp. Mod.)
Cloning via modular custom MCS
ori
attL4
pENTR_A
Cassette 1
Kan
attR1
attL1
pENTR_B
attL2
attR2
pENTR_C
attL3
E
Expression Construct
(9 Exp. Mod.)
Cloning via Multisite Gateway? (Invitrogen)
attB4
attB1
attB2
attB3
Plant expression construct
ori
Strep

Fig. 4

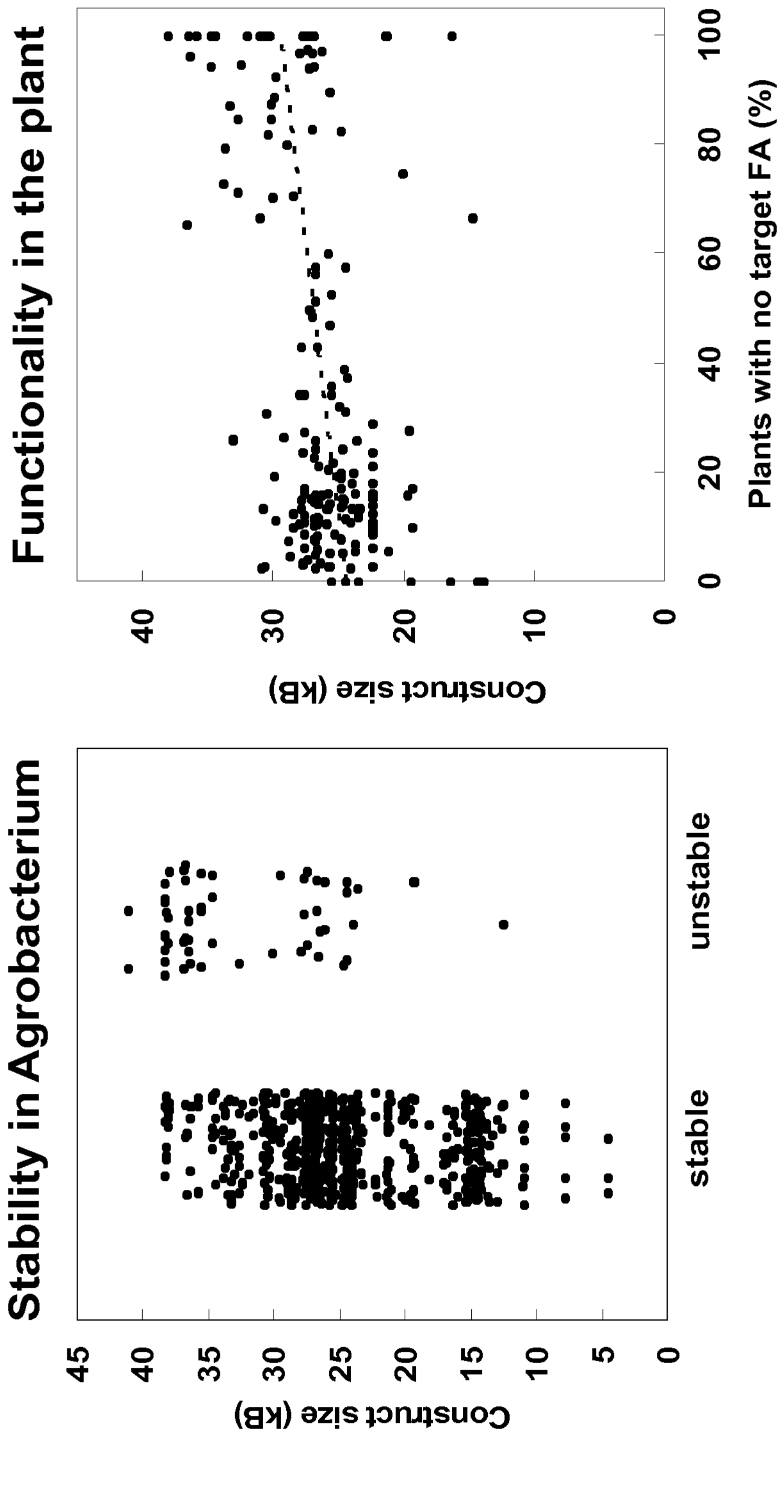

Stability in Agrobacterium
Construct size (kB)
45
40
35
30
25
20
15
10
5
0
stable
unstable
Functionality in the plant
Construct size (kB)
40
30
20
10
0
0
20
40
60
80
100
Plants with no target FA (%)

Fig. 5

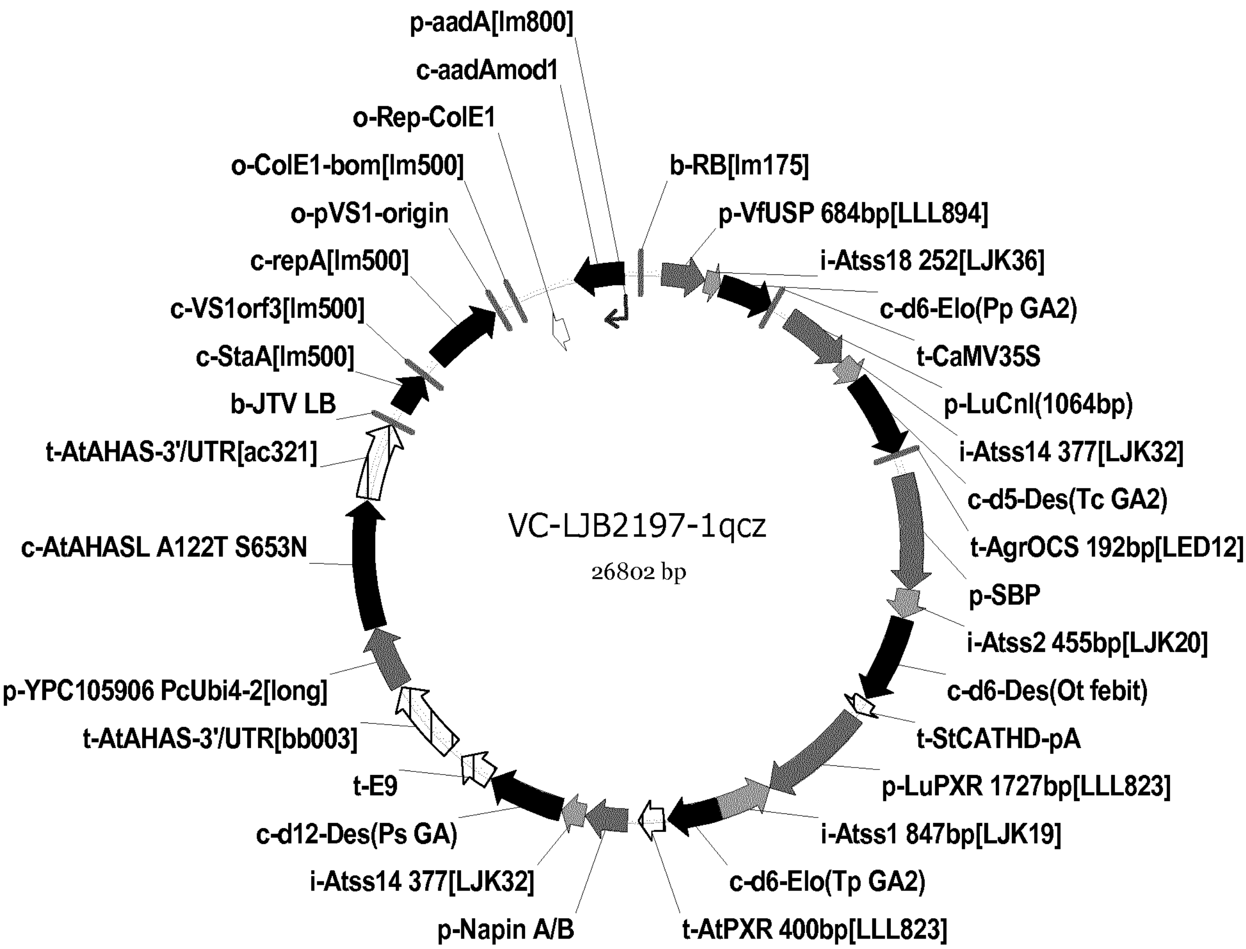

VC-LJB2197-1qcz
26802 bp
p-aadA[lm800]
c-aadAmod1
o-Rep-ColE1
o-ColE1-bom[lm500]
o-pVS1-origin
c-repA[lm500]
c-VS1orf3[lm500]
c-StaA[lm500]
b-JTV LB
t-AtAHAS-3'/UTR[ac321]
c-AtAHASL A122T S653N
p-YPC105906 PcUbi4-2[long]
t-AtAHAS-3'/UTR[bb003]
t-E9
c-d12-Des(Ps GA)
i-Atss14 377[LJK32]
p-Napin A/B
t-AtPXR 400bp[LLL823]
c-d6-Elo(Tp GA2)
i-Atss1 847bp[LJK19]
p-LuPXR 1727bp[LLL823]
t-StCATHD-pA
c-d6-Des(Ot febit)
i-Atss2 455bp[LJK20]
p-SBP
t-AgrOCS 192bp[LED12]
c-d5-Des(Tc GA2)
i-Atss14 377[LJK32]
p-LuCnl(1064bp)
t-CaMV35S
c-d6-Elo(Pp GA2)
i-Atss18 252[LJK36]
p-VfUSP 684bp[LLL894]
b-RB[lm175]

Fig. 6

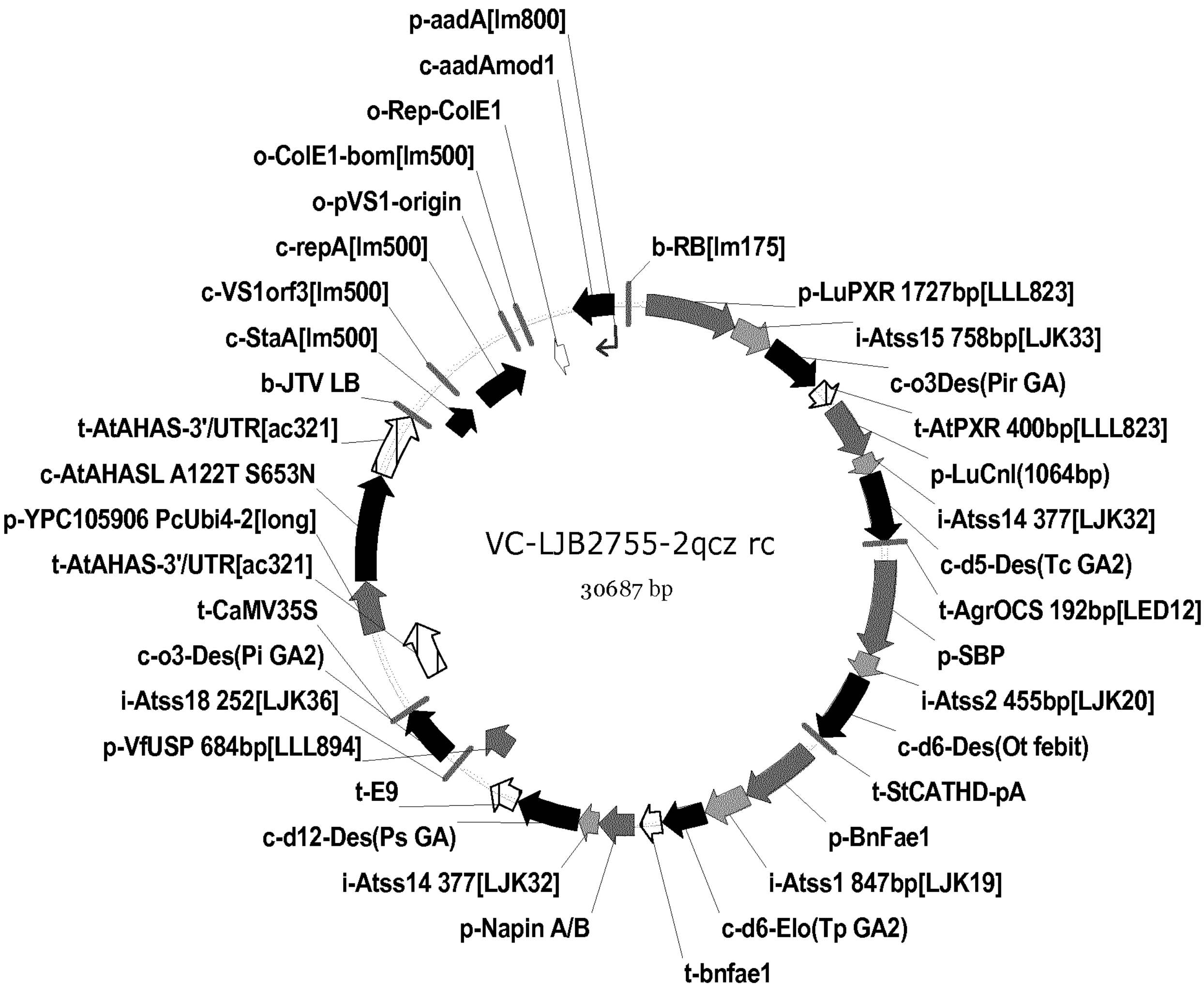

p-aadA[Im800]
c-aadAmod1
o-Rep-ColE1
o-ColE1-bom[Im500]
o-pVS1-origin
c-repA[Im500]
c-VS1orf3[Im500]
c-StaA[Im500]
b-JTV LB
t-AtAHAS-3'/UTR[ac321]
c-AtAHASL A122T S653N
p-YPC105906 PcUbi4-2[long]
t-AtAHAS-3'/UTR[ac321]
t-CaMV35S
c-o3-Des(Pi GA2)
i-Atss18 252[LJK36]
p-VfUSP 684bp[LLL894]
t-E9
c-d12-Des(Ps GA)
i-Atss14 377[LJK32]
p-Napin A/B
t-bnfae1
c-d6-Elo(Tp GA2)
i-Atss1 847bp[LJK19]
p-BnFae1
t-StCATHD-pA
c-d6-Des(Ot febit)
i-Atss2 455bp[LJK20]
p-SBP
t-AgrOCS 192bp[LED12]
c-d5-Des(Tc GA2)
i-Atss14 377[LJK32]
p-LuCnl(1064bp)
t-AtPXR 400bp[LLL823]
c-o3Des(Pir GA)
i-Atss15 758bp[LJK33]
p-LuPXR 1727bp[LLL823]
b-RB[Im175]
VC-LJB2755-2qcz rc
30687 bp

Fig. 7

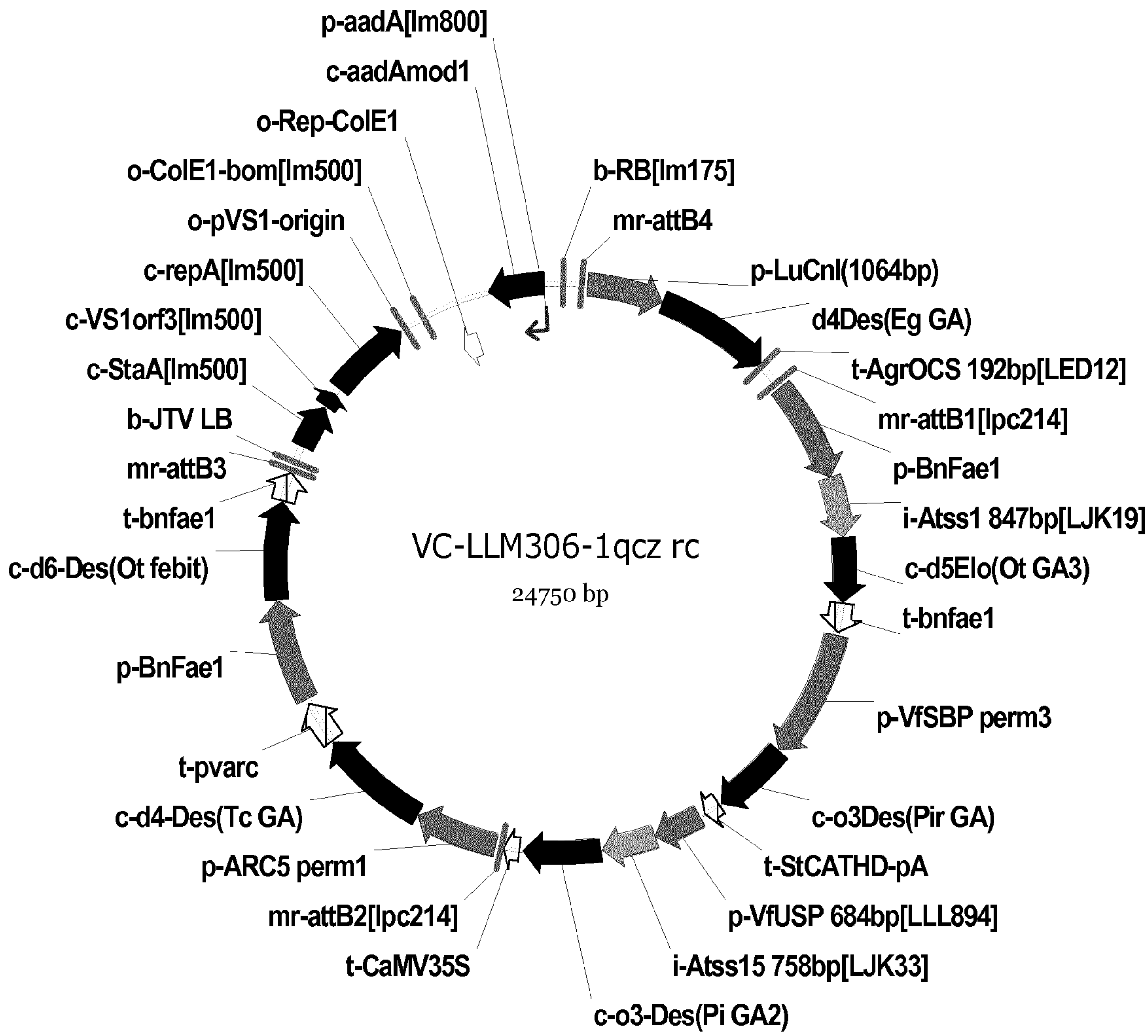

p-aadA[lm800]
c-aadAmod1
o-Rep-ColE1
o-ColE1-bom[lm500]
o-pVS1-origin
c-repA[lm500]
c-VS1orf3[lm500]
c-StaA[lm500]
b-JTV LB
mr-attB3
t-bnfae1
c-d6-Des(Ot febit)
p-BnFae1
t-pvarc
c-d4-Des(Tc GA)
p-ARC5 perm1
mr-attB2[lpc214]
t-CaMV35S
c-o3-Des(Pi GA2)
i-Atss15 758bp[LJK33]
p-VfUSP 684bp[LLL894]
t-StCATHD-pA
c-o3Des(Pir GA)
p-VfSBP perm3
t-bnfae1
c-d5Elo(Ot GA3)
i-Atss1 847bp[LJK19]
p-BnFae1
mr-attB1[lpc214]
t-AgrOCS 192bp[LED12]
d4Des(Eg GA)
p-LuCnl(1064bp)
mr-attB4
b-RB[lm175]
VC-LLM306-1qcz rc
24750 bp

Fig. 8

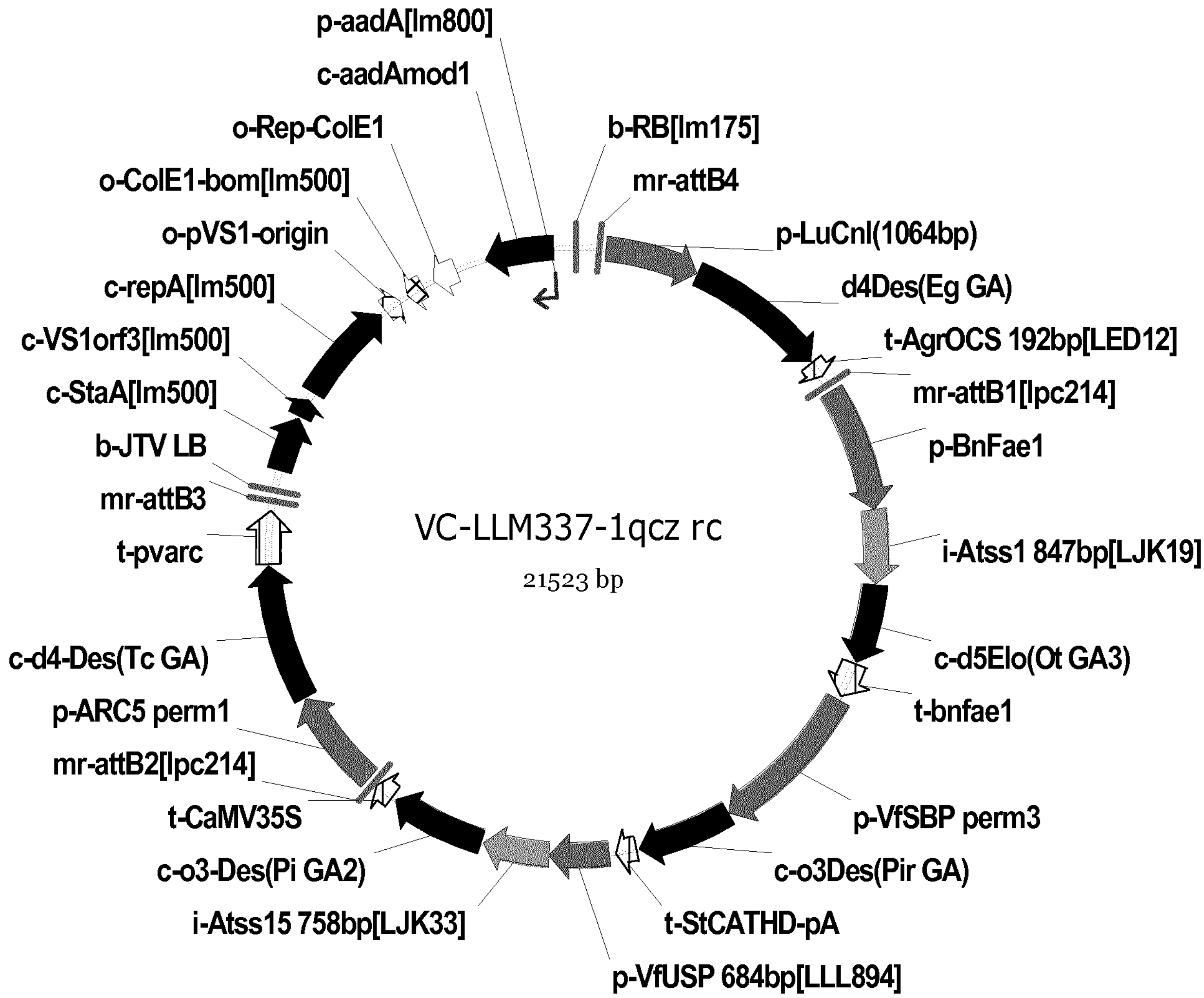

VC-LLM337-1qcz rc
21523 bp
p-aadA[lm800]
c-aadAmod1
o-Rep-ColE1
o-ColE1-bom[lm500]
o-pVS1-origin
c-repA[lm500]
c-VS1orf3[lm500]
c-StaA[lm500]
b-JTV LB
mr-attB3
t-pvarc
c-d4-Des(Tc GA)
p-ARC5 perm1
mr-attB2[lpc214]
t-CaMV35S
c-o3-Des(Pi GA2)
i-Atss15 758bp[LJK33]
p-VfUSP 684bp[LLL894]
t-StCATHD-pA
c-o3Des(Pir GA)
p-VfSBP perm3
t-bnfae1
c-d5Elo(Ot GA3)
i-Atss1 847bp[LJK19]
p-BnFae1
mr-attB1[lpc214]
t-AgrOCS 192bp[LED12]
d4Des(Eg GA)
p-LuCnl(1064bp)
mr-attB4
b-RB[lm175]

Fig. 9

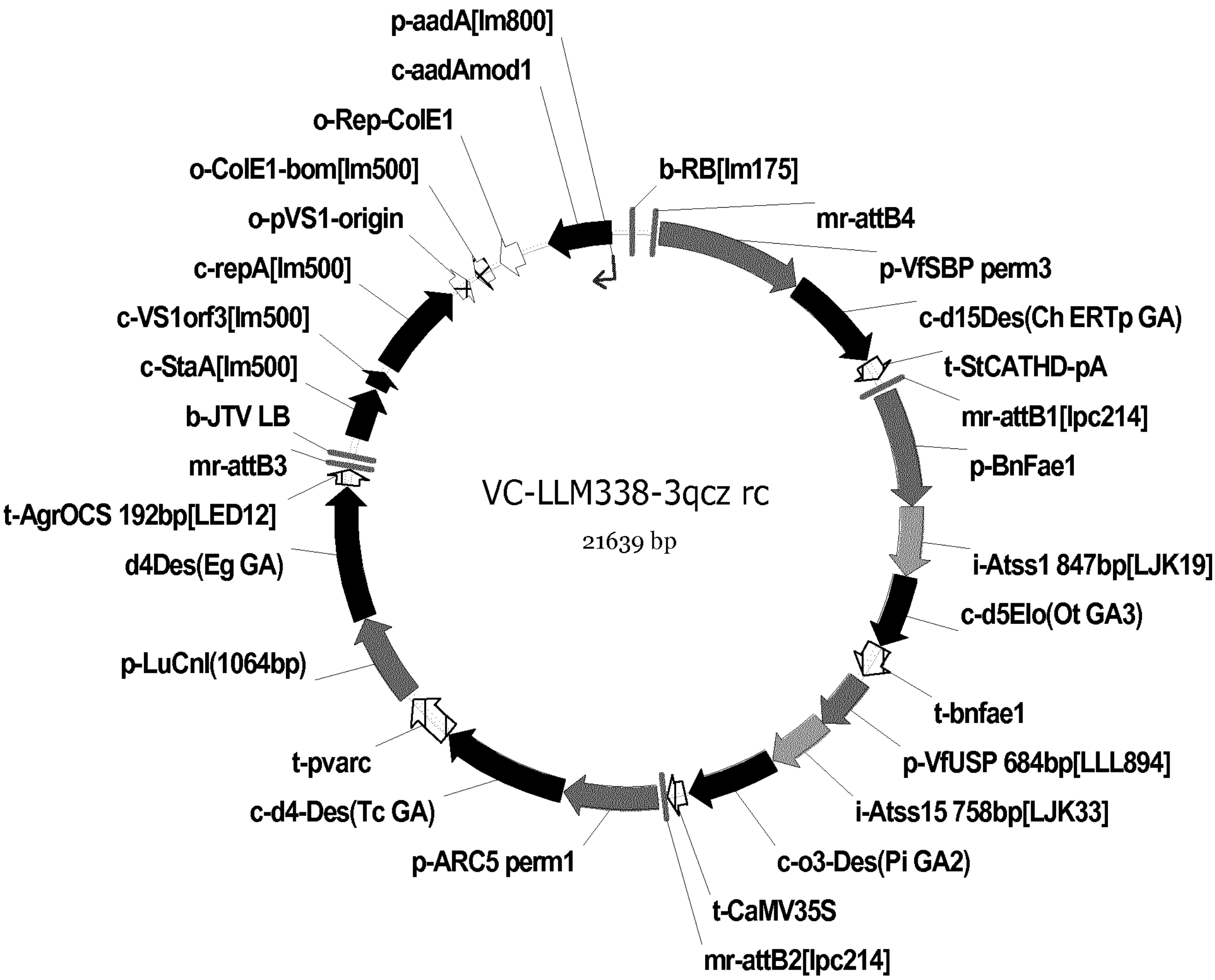

p-aadA[lm800]
c-aadAmod1
o-Rep-ColE1
o-ColE1-bom[lm500]
o-pVS1-origin
c-repA[lm500]
c-VS1orf3[lm500]
c-StaA[lm500]
b-JTV LB
mr-attB3
t-AgrOCS 192bp[LED12]
d4Des(Eg GA)
p-LuCnl(1064bp)
t-pvarc
c-d4-Des(Tc GA)
p-ARC5 perm1
b-RB[lm175]
mr-attB4
p-VfSBP perm3
c-d15Des(Ch ERTp GA)
t-StCATHD-pA
mr-attB1[lpc214]
p-BnFae1
i-Atss1 847bp[LJK19]
c-d5Elo(Ot GA3)
t-bnfae1
p-VfUSP 684bp[LLL894]
i-Atss15 758bp[LJK33]
c-o3-Des(Pi GA2)
t-CaMV35S
mr-attB2[lpc214]
VC-LLM338-3qcz rc
21639 bp

Fig. 10

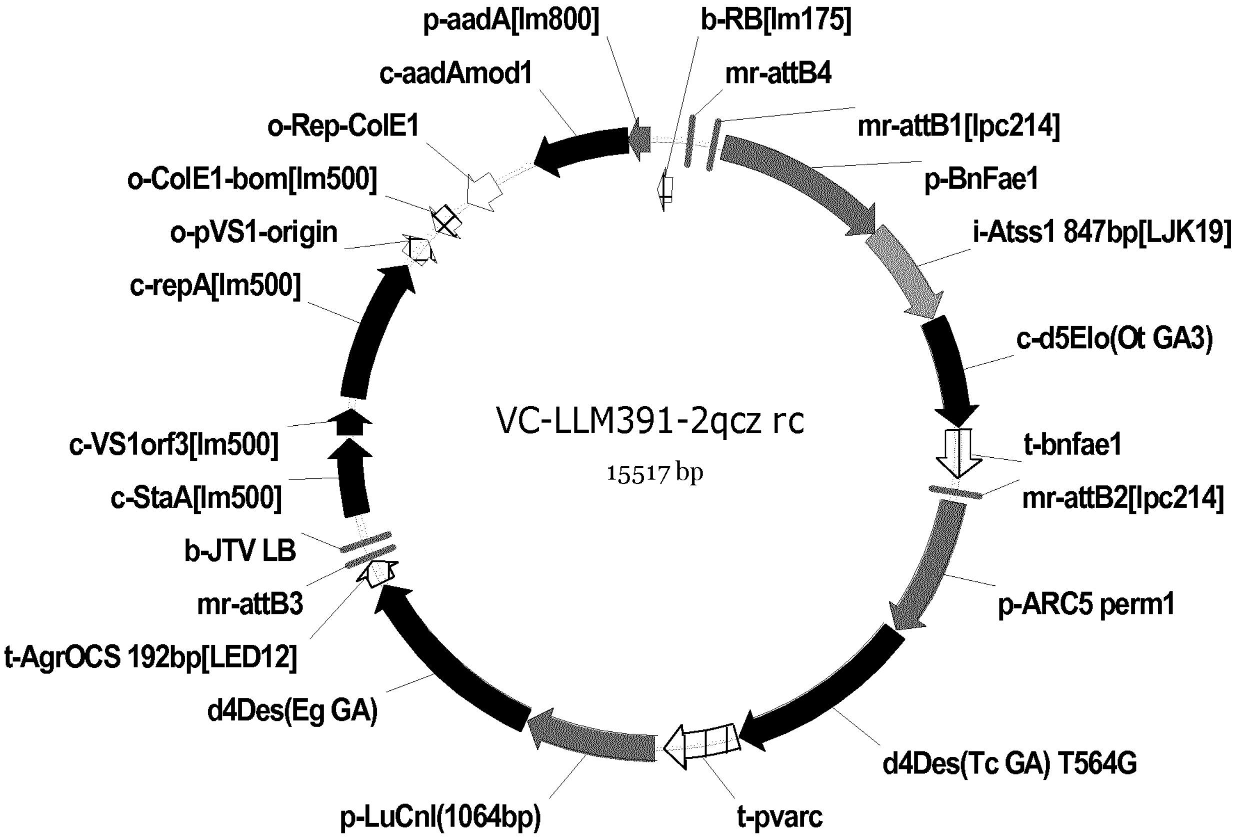

VC-LLM391-2qcz rc
15517 bp
p-aadA[lm800]
b-RB[lm175]
mr-attB4
mr-attB1[lpc214]
p-BnFae1
i-Atss1 847bp[LJK19]
c-d5Elo(Ot GA3)
t-bnfae1
mr-attB2[lpc214]
p-ARC5 perm1
d4Des(Tc GA) T564G
t-pvarc
p-LuCnl(1064bp)
d4Des(Eg GA)
t-AgrOCS 192bp[LED12]
mr-attB3
b-JTV LB
c-StaA[lm500]
c-VS1orf3[lm500]
c-repA[lm500]
o-pVS1-origin
o-ColE1-bom[lm500]
o-Rep-ColE1
c-aadAmod1

Fig. 11

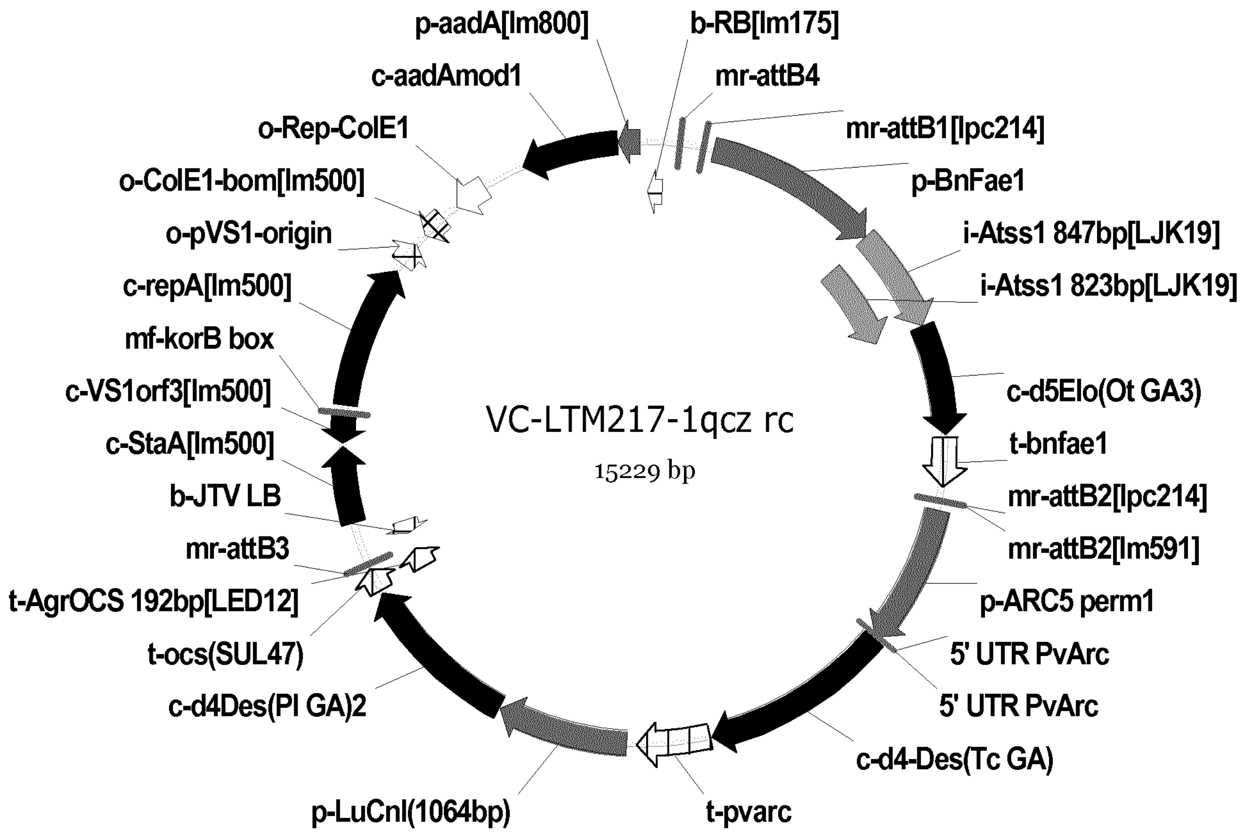

p-aadA[Im800]
b-RB[Im175]
c-aadAmod1
mr-attB4
o-Rep-ColE1
mr-attB1[lpc214]
o-ColE1-bom[Im500]
p-BnFae1
o-pVS1-origin
i-Atss1 847bp[LJK19]
c-repA[Im500]
i-Atss1 823bp[LJK19]
mf-korB box
c-VS1orf3[Im500]
c-d5Elo(Ot GA3)
VC-LTM217-1qcz rc
15229 bp
c-StaA[Im500]
t-bnfae1
b-JTV LB
mr-attB2[lpc214]
mr-attB3
mr-attB2[Im591]
t-AgrOCS 192bp[LED12]
p-ARC5 perm1
t-ocs(SUL47)
5' UTR PvArc
c-d4Des(Pl GA)2
5' UTR PvArc
c-d4-Des(Tc GA)
p-LuCnl(1064bp)
t-pvarc

Fig 12

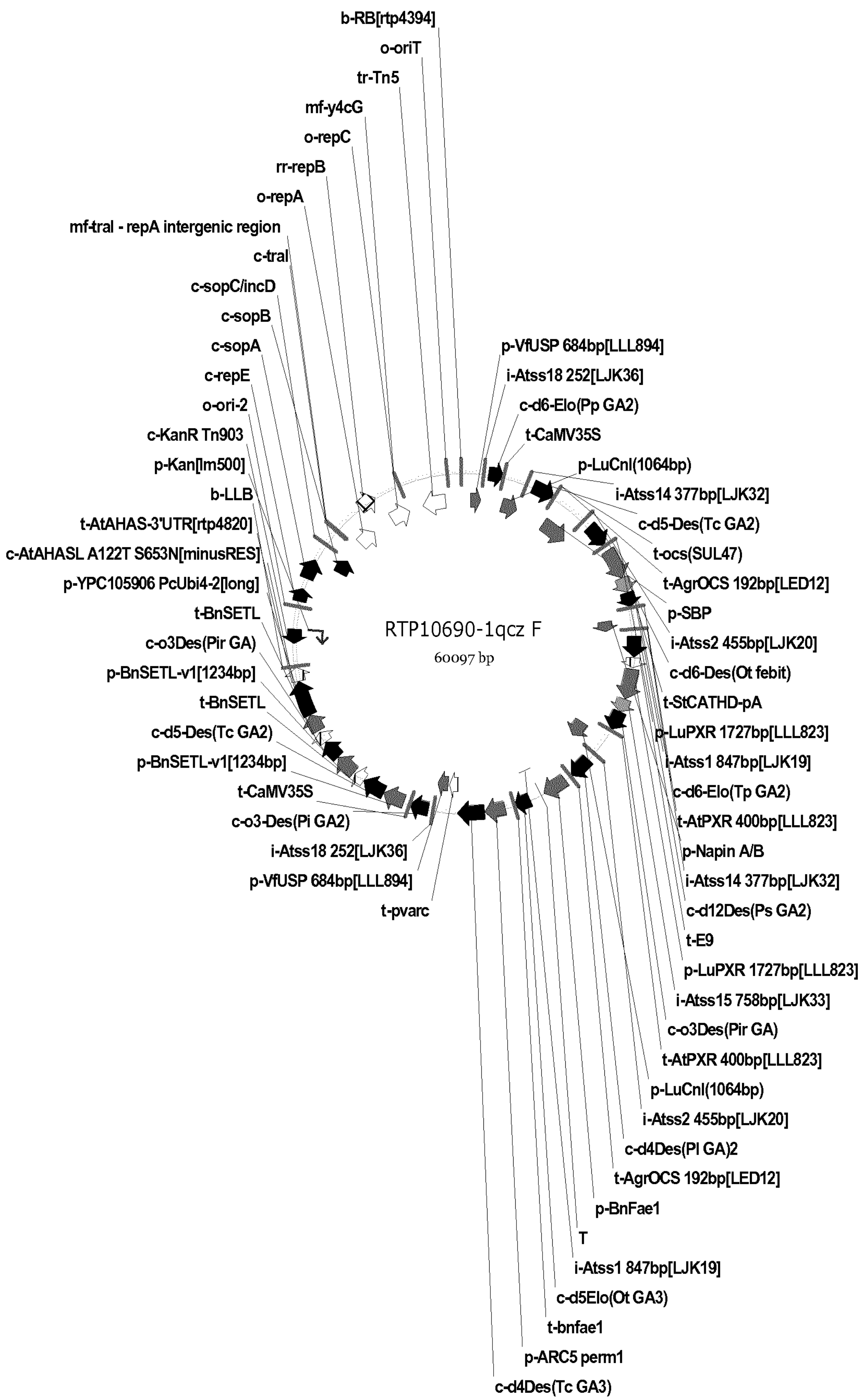

b-RB[rtp4394]
o-oriT
tr-Tn5
mf-y4cG
o-repC
rr-repB
o-repA
mf-traI - repA intergenic region
c-traI
c-sopC/incD
c-sopB
c-sopA
c-repE
o-ori-2
c-KanR Tn903
p-Kan[lm500]
b-LLB
t-AtAHAS-3'UTR[rtp4820]
c-AtAHASL A122T S653N[minusRES]
p-YPC105906 PcUbi4-2[long]
t-BnSETL
c-o3Des(Pir GA)
p-BnSETL-v1[1234bp]
t-BnSETL
c-d5-Des(Tc GA2)
p-BnSETL-v1[1234bp]
t-CaMV35S
c-o3-Des(Pi GA2)
i-Atss18 252[LJK36]
p-VfUSP 684bp[LLL894]
t-pvarc
RTP10690-1qcz F
60097 bp
p-VfUSP 684bp[LLL894]
i-Atss18 252[LJK36]
c-d6-Elo(Pp GA2)
t-CaMV35S
p-LuCnl(1064bp)
i-Atss14 377bp[LJK32]
c-d5-Des(Tc GA2)
t-ocs(SUL47)
t-AgrOCS 192bp[LED12]
p-SBP
i-Atss2 455bp[LJK20]
c-d6-Des(Ot febit)
t-StCATHD-pA
p-LuPXR 1727bp[LLL823]
i-Atss1 847bp[LJK19]
c-d6-Elo(Tp GA2)
t-AtPXR 400bp[LLL823]
p-Napin A/B
i-Atss14 377bp[LJK32]
c-d12Des(Ps GA2)
t-E9
p-LuPXR 1727bp[LLL823]
i-Atss15 758bp[LJK33]
c-o3Des(Pir GA)
t-AtPXR 400bp[LLL823]
p-LuCnl(1064bp)
i-Atss2 455bp[LJK20]
c-d4Des(Pl GA)2
t-AgrOCS 192bp[LED12]
p-BnFae1
T
i-Atss1 847bp[LJK19]
c-d5Elo(Ot GA3)
t-bnfae1
p-ARC5 perm1
c-d4Des(Tc GA3)

Fig. 13

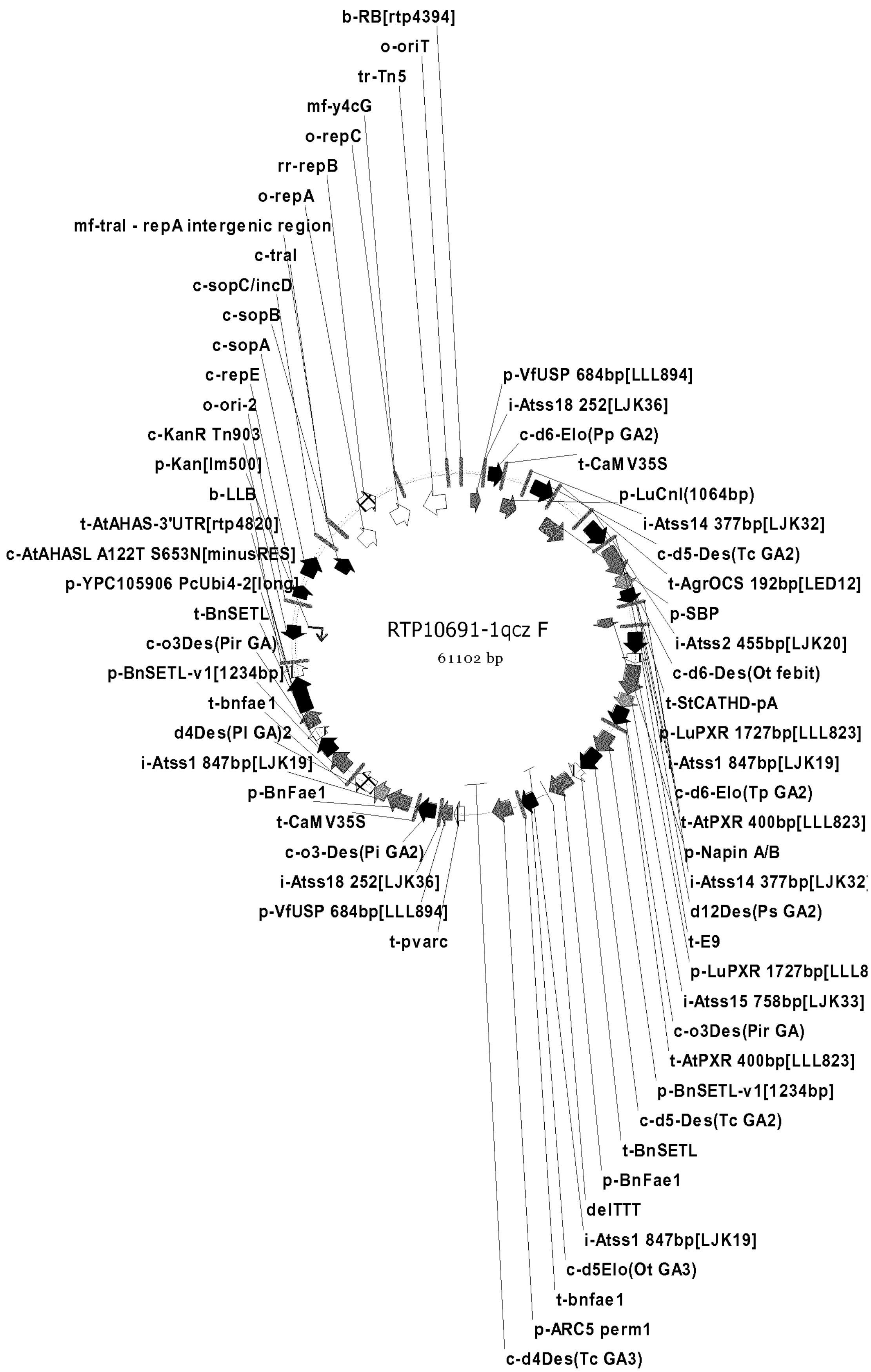

b-RB[rtp4394]
o-oriT
tr-Tn5
mf-y4cG
o-repC
rr-repB
o-repA
mf-traI - repA intergenic region
c-traI
c-sopC/incD
c-sopB
c-sopA
c-repE
o-ori-2
c-KanR Tn903
p-Kan[lm500]
b-LLB
t-AtAHAS-3'UTR[rtp4820]
c-AtAHASL A122T S653N[minusRES]
p-YPC105906 PcUbi4-2[long]
t-BnSETL
c-o3Des(Pir GA)
p-BnSETL-v1[1234bp]
t-bnfae1
d4Des(Pl GA)2
i-Atss1 847bp[LJK19]
p-BnFae1
t-CaMV35S
c-o3-Des(Pi GA2)
i-Atss18 252[LJK36]
p-VfUSP 684bp[LLL894]
t-pvarc
RTP10691-1qcz F
61102 bp
p-VfUSP 684bp[LLL894]
i-Atss18 252[LJK36]
c-d6-Elo(Pp GA2)
t-CaMV35S
p-LuCnl(1064bp)
i-Atss14 377bp[LJK32]
c-d5-Des(Tc GA2)
t-AgrOCS 192bp[LED12]
p-SBP
i-Atss2 455bp[LJK20]
c-d6-Des(Ot febit)
t-StCATHD-pA
p-LuPXR 1727bp[LLL823]
i-Atss1 847bp[LJK19]
c-d6-Elo(Tp GA2)
t-AtPXR 400bp[LLL823]
p-Napin A/B
i-Atss14 377bp[LJK32
d12Des(Ps GA2)
t-E9
p-LuPXR 1727bp[LLL8
i-Atss15 758bp[LJK33]
c-o3Des(Pir GA)
t-AtPXR 400bp[LLL823]
p-BnSETL-v1[1234bp]
c-d5-Des(Tc GA2)
t-BnSETL
p-BnFae1
delTTT
i-Atss1 847bp[LJK19]
c-d5Elo(Ot GA3)
t-bnfae1
p-ARC5 perm1
c-d4Des(Tc GA3)

Fig. 14

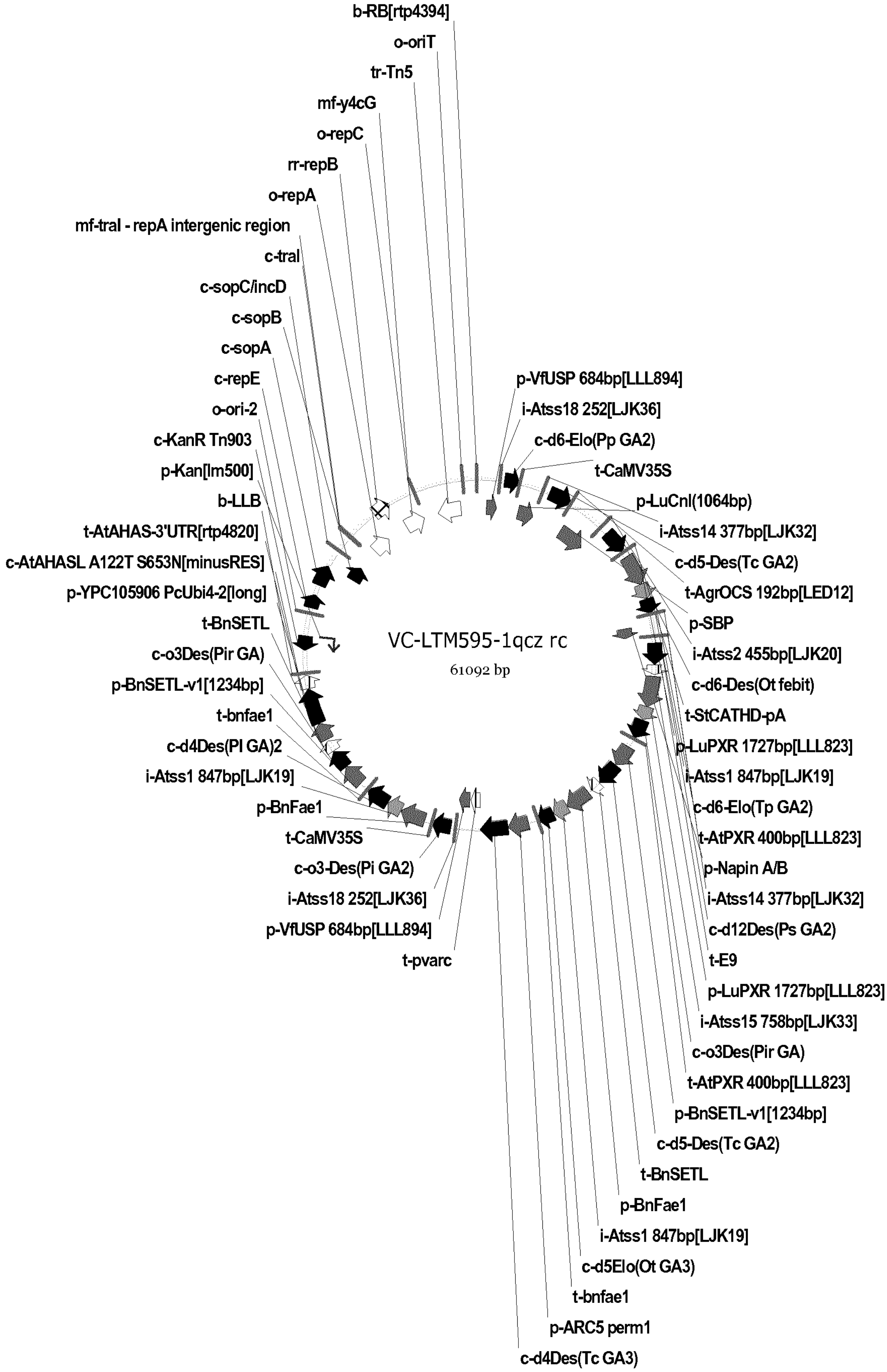

b-RB[rtp4394]
o-oriT
tr-Tn5
mf-y4cG
o-repC
rr-repB
o-repA
mf-traI - repA intergenic region
c-traI
c-sopC/incD
c-sopB
c-sopA
c-repE
o-ori-2
c-KanR Tn903
p-Kan[lm500]
b-LLB
t-AtAHAS-3'UTR[rtp4820]
c-AtAHASL A122T S653N[minusRES]
p-YPC105906 PcUbi4-2[long]
t-BnSETL
c-o3Des(Pir GA)
p-BnSETL-v1[1234bp]
t-bnfae1
c-d4Des(Pl GA)2
i-Atss1 847bp[LJK19]
p-BnFae1
t-CaMV35S
c-o3-Des(Pi GA2)
i-Atss18 252[LJK36]
p-VfUSP 684bp[LLL894]
t-pvarc
VC-LTM595-1qcz rc
61092 bp
p-VfUSP 684bp[LLL894]
i-Atss18 252[LJK36]
c-d6-Elo(Pp GA2)
t-CaMV35S
p-LuCnl(1064bp)
i-Atss14 377bp[LJK32]
c-d5-Des(Tc GA2)
t-AgrOCS 192bp[LED12]
p-SBP
i-Atss2 455bp[LJK20]
c-d6-Des(Ot febit)
t-StCATHD-pA
p-LuPXR 1727bp[LLL823]
i-Atss1 847bp[LJK19]
c-d6-Elo(Tp GA2)
t-AtPXR 400bp[LLL823]
p-Napin A/B
i-Atss14 377bp[LJK32]
c-d12Des(Ps GA2)
t-E9
p-LuPXR 1727bp[LLL823]
i-Atss15 758bp[LJK33]
c-o3Des(Pir GA)
t-AtPXR 400bp[LLL823]
p-BnSETL-v1[1234bp]
c-d5-Des(Tc GA2)
t-BnSETL
p-BnFae1
i-Atss1 847bp[LJK19]
c-d5Elo(Ot GA3)
t-bnfae1
p-ARC5 perm1
c-d4Des(Tc GA3)

Fig. 15

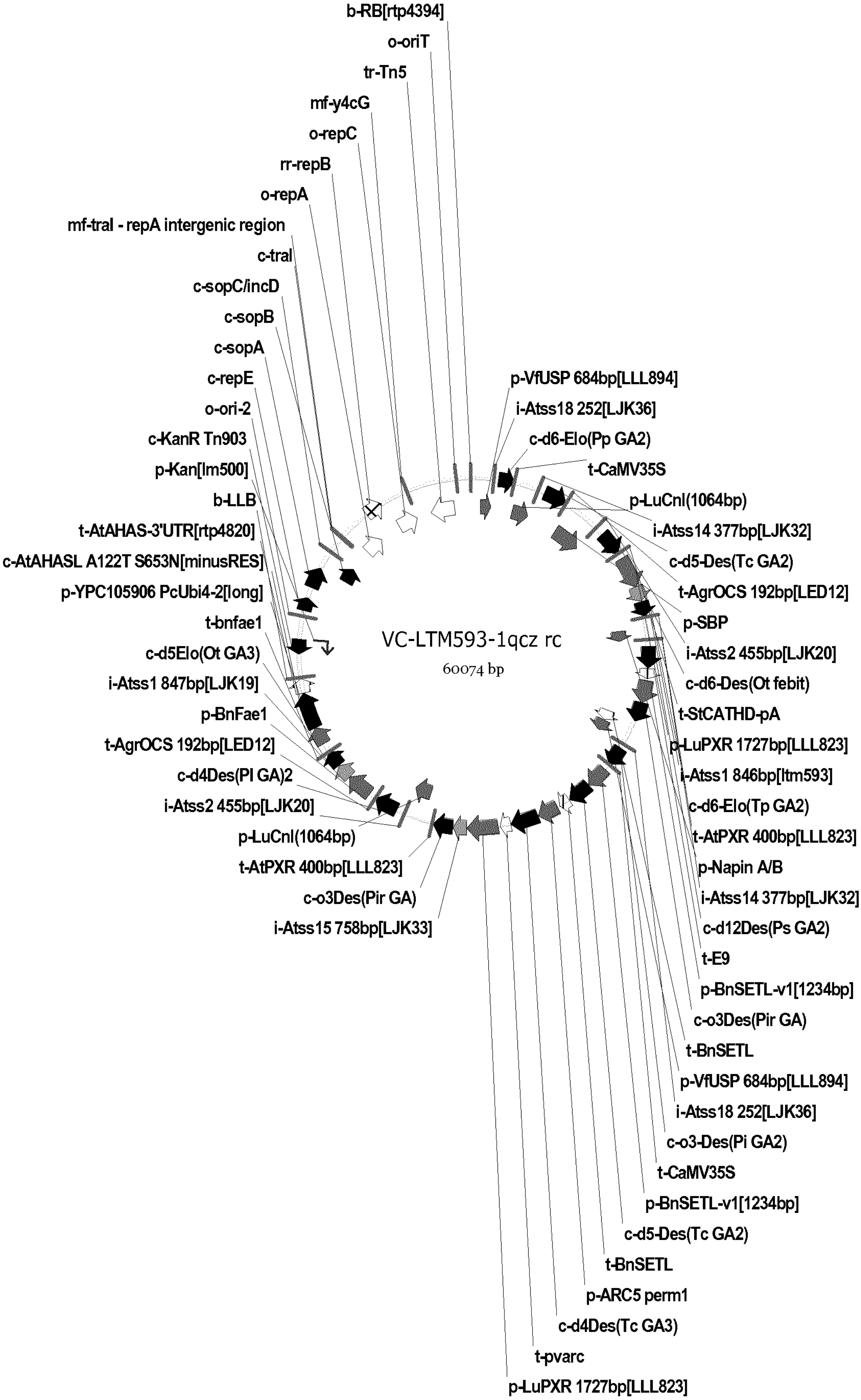

b-RB[rtp4394]
o-oriT
tr-Tn5
mf-y4cG
o-repC
rr-repB
o-repA
mf-traI - repA intergenic region
c-traI
c-sopC/incD
c-sopB
c-sopA
c-repE
o-ori-2
c-KanR Tn903
p-Kan[lm500]
b-LLB
t-AtAHAS-3'UTR[rtp4820]
c-AtAHASL A122T S653N[minusRES]
p-YPC105906 PcUbi4-2[long]
t-bnfae1
c-d5Elo(Ot GA3)
i-Atss1 847bp[LJK19]
p-BnFae1
t-AgrOCS 192bp[LED12]
c-d4Des(Pl GA)2
i-Atss2 455bp[LJK20]
p-LuCnl(1064bp)
t-AtPXR 400bp[LLL823]
c-o3Des(Pir GA)
i-Atss15 758bp[LJK33]
p-VfUSP 684bp[LLL894]
i-Atss18 252[LJK36]
c-d6-Elo(Pp GA2)
t-CaMV35S
p-LuCnl(1064bp)
i-Atss14 377bp[LJK32]
c-d5-Des(Tc GA2)
t-AgrOCS 192bp[LED12]
p-SBP
i-Atss2 455bp[LJK20]
c-d6-Des(Ot febit)
t-StCATHD-pA
p-LuPXR 1727bp[LLL823]
i-Atss1 846bp[ltm593]
c-d6-Elo(Tp GA2)
t-AtPXR 400bp[LLL823]
p-Napin A/B
i-Atss14 377bp[LJK32]
c-d12Des(Ps GA2)
t-E9
p-BnSETL-v1[1234bp]
c-o3Des(Pir GA)
t-BnSETL
p-VfUSP 684bp[LLL894]
i-Atss18 252[LJK36]
c-o3-Des(Pi GA2)
t-CaMV35S
p-BnSETL-v1[1234bp]
c-d5-Des(Tc GA2)
t-BnSETL
p-ARC5 perm1
c-d4Des(Tc GA3)
t-pvarc
p-LuPXR 1727bp[LLL823]
VC-LTM593-1qcz rc
60074 bp

Fig. 16

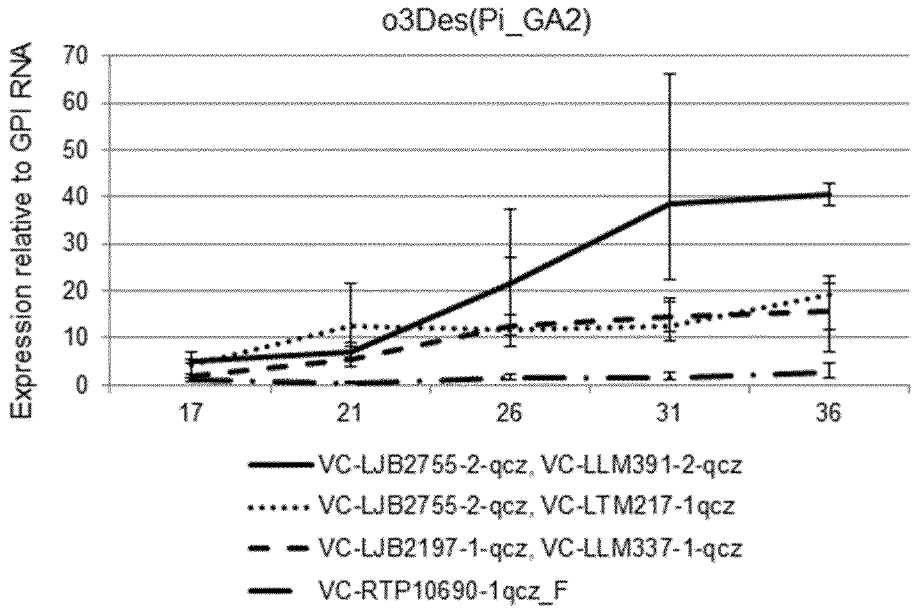

o3Des(Pi_GA2)
Expression relative to GPI RNA
70
60
50
40
30
20
10
0
17
21
26
31
36
VC-LJB2755-2-qcz, VC-LLM391-2-qcz
VC-LJB2755-2-qcz, VC-LTM217-1qcz
VC-LJB2197-1-qcz, VC-LLM337-1-qcz
VC-RTP10690-1qcz_F

Fig. 17

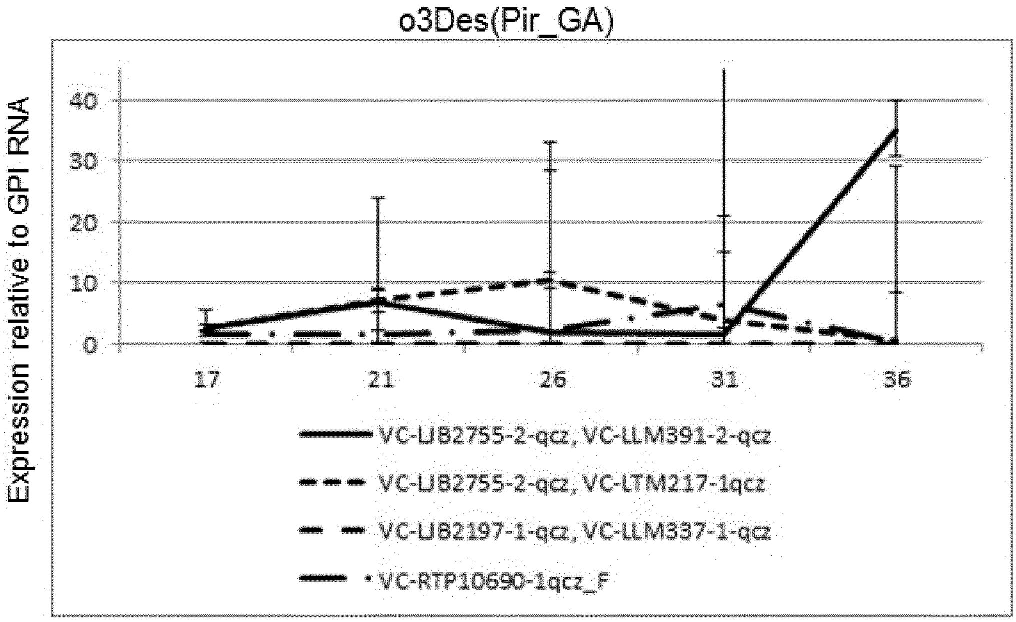

o3Des(Pir_GA)
Expression relative to GPI RNA
40
30
20
10
0
17
21
26
31
36
VC-LJB2755-2-qcz, VC-LLM391-2-qcz
VC-LJB2755-2-qcz, VC-LTM217-1qcz
VC-LJB2197-1-qcz, VC-LLM337-1-qcz
VC-RTP10690-1qcz_F

Fig. 18

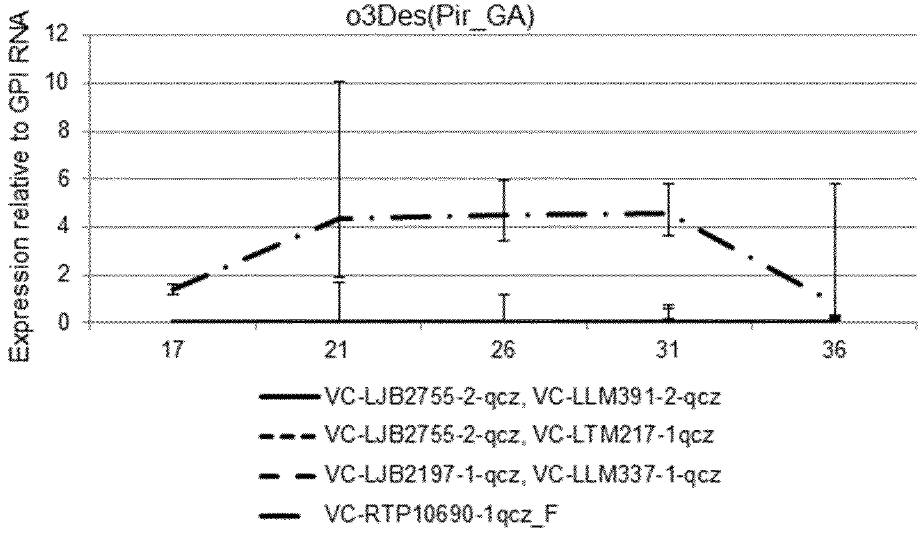

o3Des(Pir_GA)
Expression relative to GPI RNA
12
10
8
6
4
2
0
17
21
26
31
36
VC-LJB2755-2-qcz, VC-LLM391-2-qcz
VC-LJB2755-2-qcz, VC-LTM217-1qcz
VC-LJB2197-1-qcz, VC-LLM337-1-qcz
VC-RTP10690-1qcz_F

Fig. 19

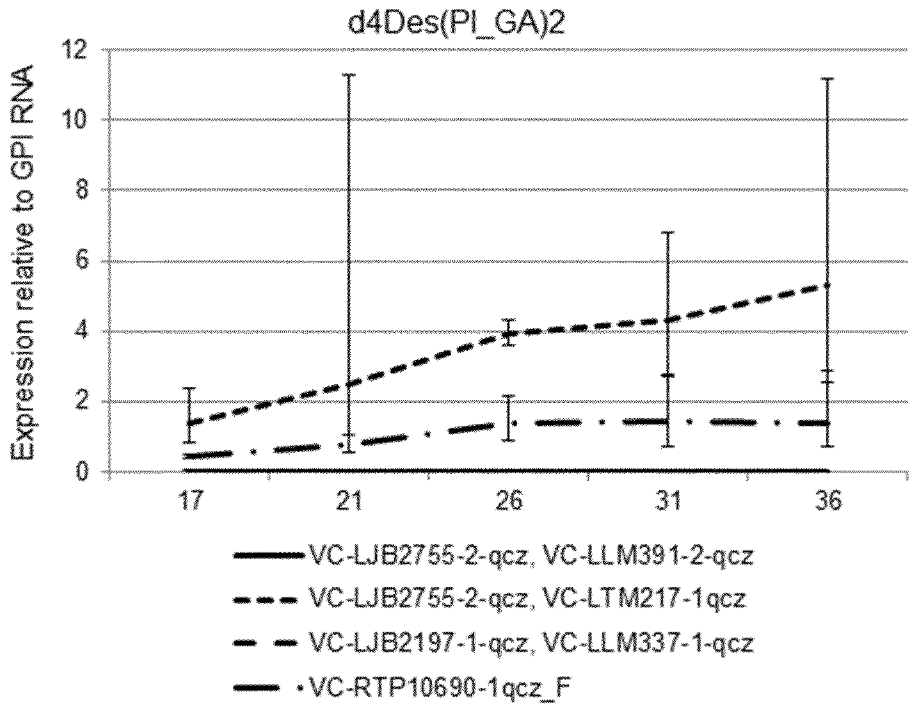

d4Des(PI_GA)2
Expression relative to GPI RNA
0
2
4
6
8
10
12
17
21
26
31
36
VC-LJB2755-2-qcz, VC-LLM391-2-qcz
VC-LJB2755-2-qcz, VC-LTM217-1qcz
VC-LJB2197-1-qcz, VC-LLM337-1-qcz
VC-RTP10690-1qcz_F

Fig. 20

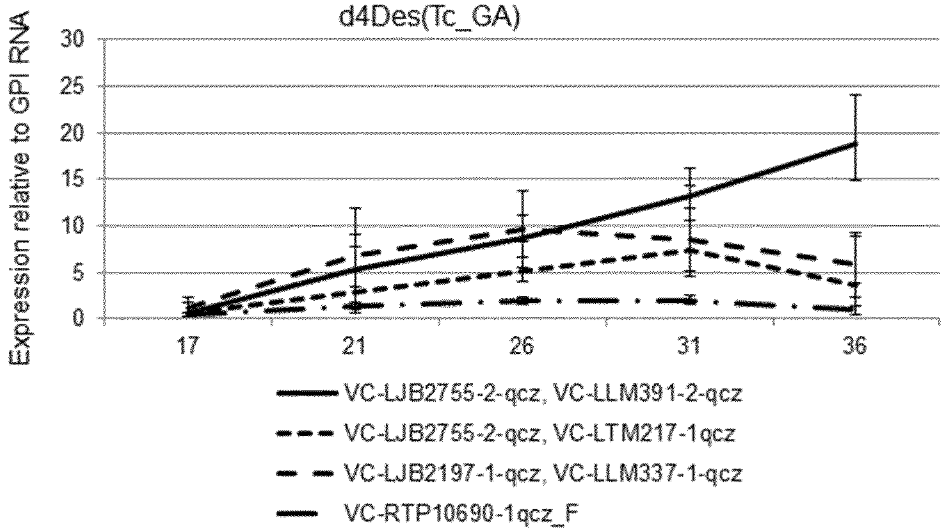

d4Des(Tc_GA)
Expression relative to GPI RNA
30
25
20
15
10
5
0
17
21
26
31
36
VC-LJB2755-2-qcz, VC-LLM391-2-qcz
VC-LJB2755-2-qcz, VC-LTM217-1qcz
VC-LJB2197-1-qcz, VC-LLM337-1-qcz
VC-RTP10690-1qcz_F

Fig. 21

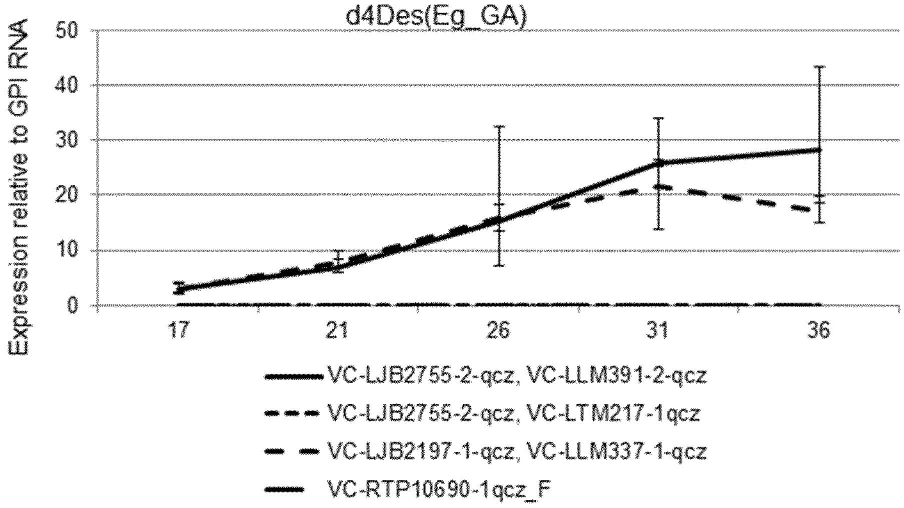

d4Des(Eg_GA)
Expression relative to GPI RNA
50
40
30
20
10
0
17
21
26
31
36
VC-LJB2755-2-qcz, VC-LLM391-2-qcz
VC-LJB2755-2-qcz, VC-LTM217-1qcz
VC-LJB2197-1-qcz, VC-LLM337-1-qcz
VC-RTP10690-1qcz_F

Fig. 22

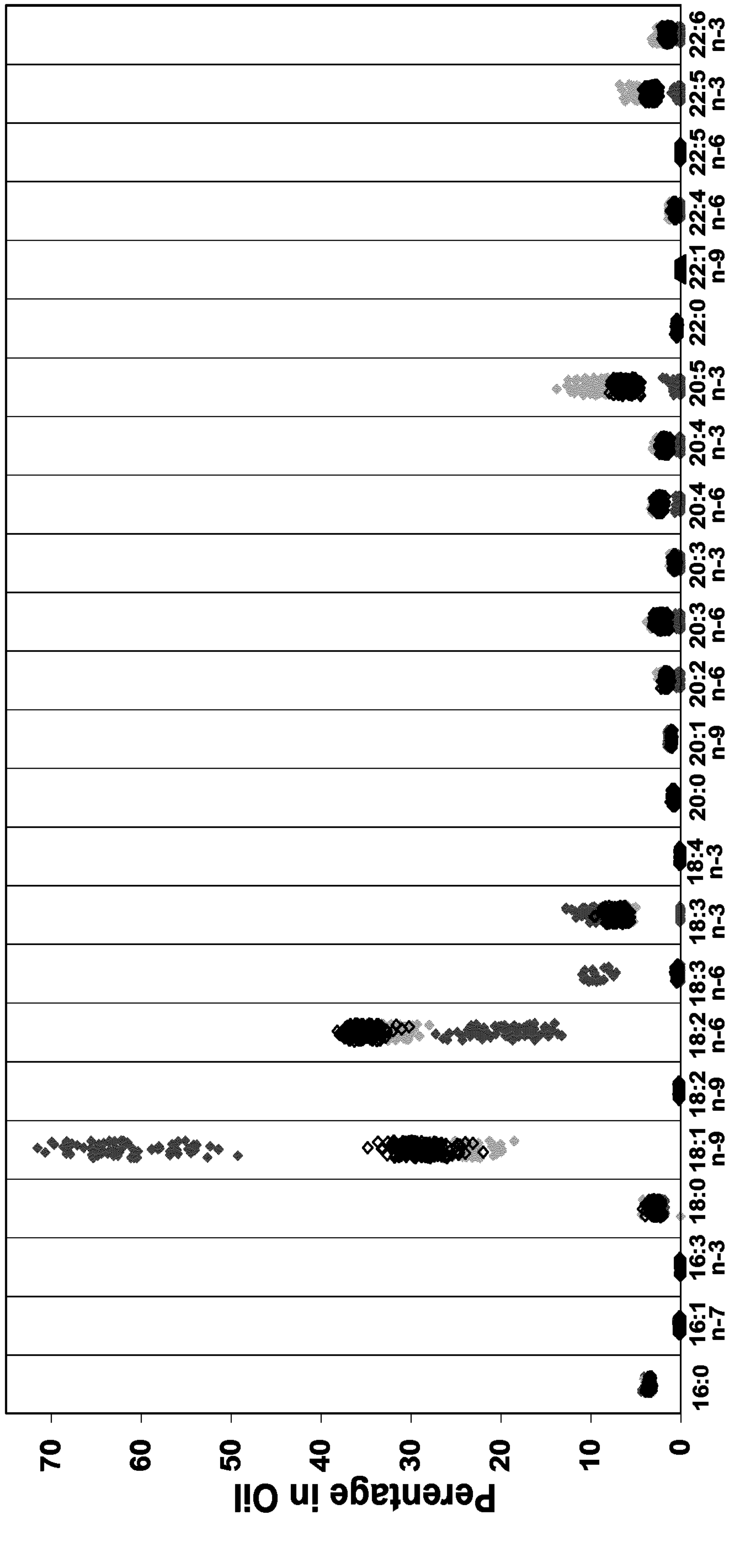

Perentage in Oil
0
10
20
30
40
50
60
70
16:0
16:1 n-7
16:3 n-3
18:0
18:1 n-9
18:2 n-9
18:2 n-6
18:3 n-6
18:3 n-3
18:4 n-3
20:0
20:1 n-9
20:2 n-6
20:3 n-6
20:3 n-3
20:4 n-6
20:4 n-3
20:5 n-3
22:0
22:1 n-9
22:4 n-6
22:5 n-6
22:5 n-3
22:6 n-3

Fig. 23

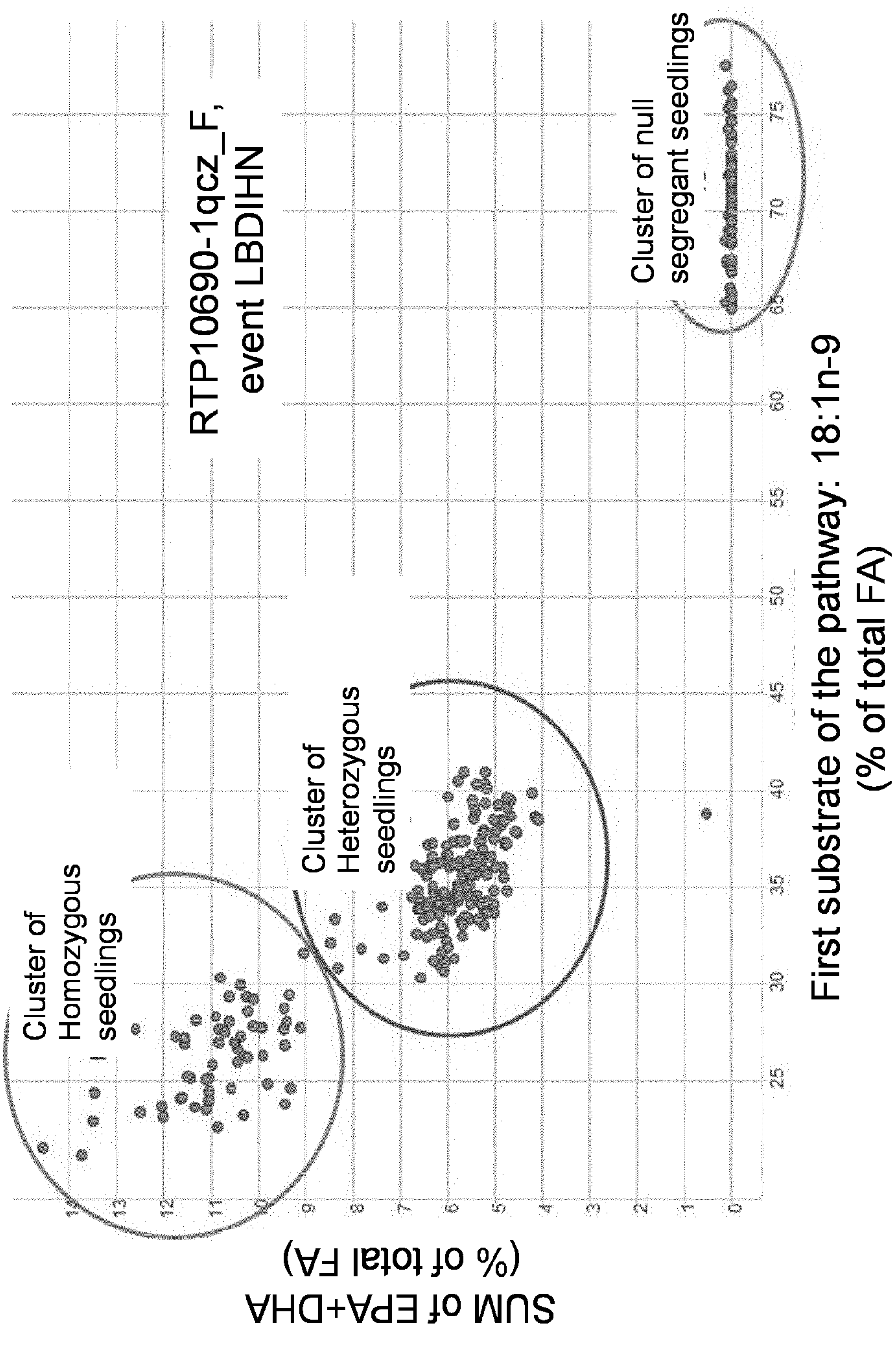

RTP10690-1qcz_F,
event LBDIHN
Cluster of
Homozygous
seedlings
Cluster of
Heterozygous
seedlings
Cluster of null
segregant seedlings
SUM of EPA+DHA
(% of total FA)
First substrate of the pathway: 18:1n-9
(% of total FA)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
25
30
35
40
45
50
55
60
65
70
75

Fig. 24

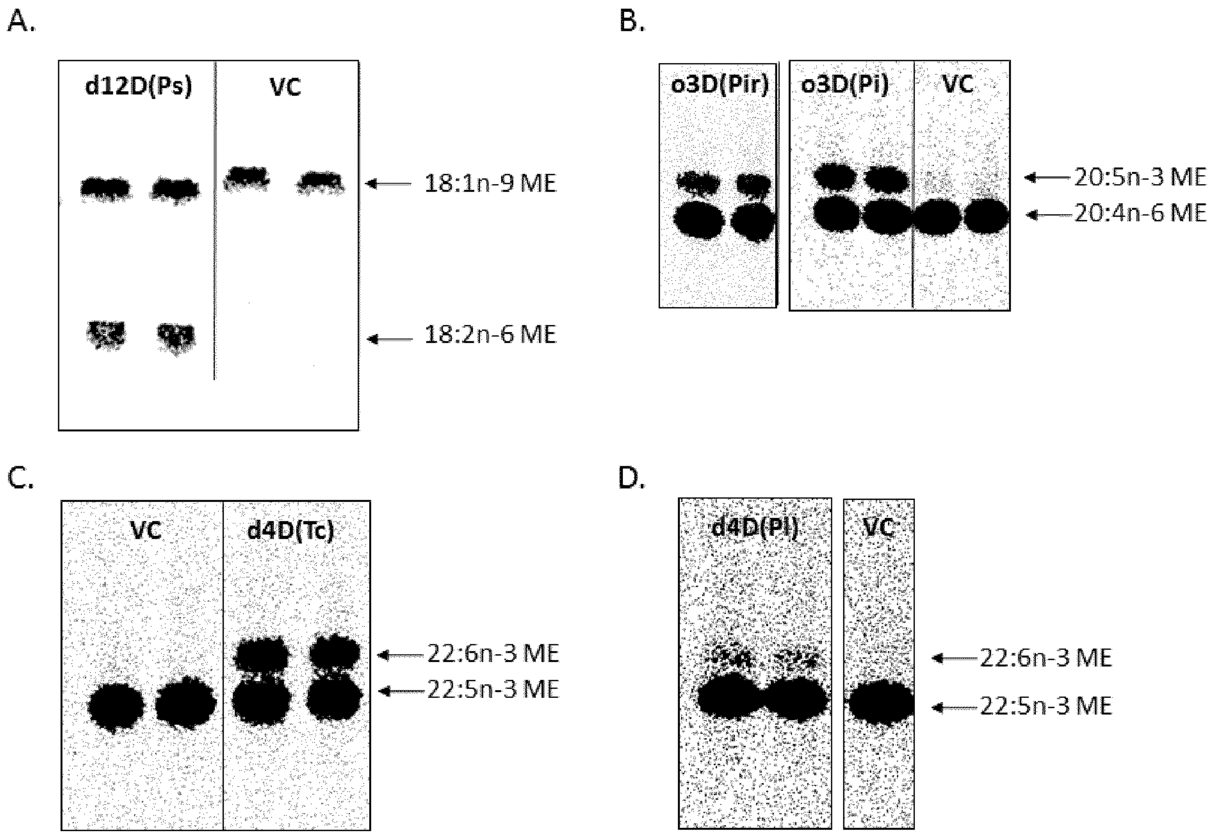
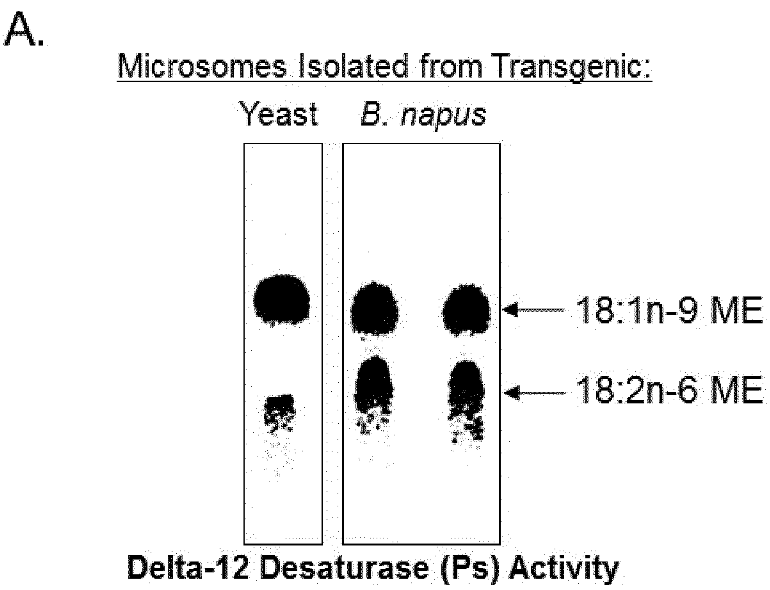

A.
d12D(Ps)
VC
18:1n-9 ME
18:2n-6 ME
B.
o3D(Pir)
o3D(Pi)
VC
20:5n-3 ME
20:4n-6 ME
C.
VC
d4D(Tc)
22:6n-3 ME
22:5n-3 ME
D.
d4D(Pl)
VC
22:6n-3 ME
22:5n-3 ME

Fig. 25


A.
Microsomes Isolated from Transgenic:
Yeast
B. napus
18:1n-9 ME
18:2n-6 ME
Delta-12 Desaturase (Ps) Activity

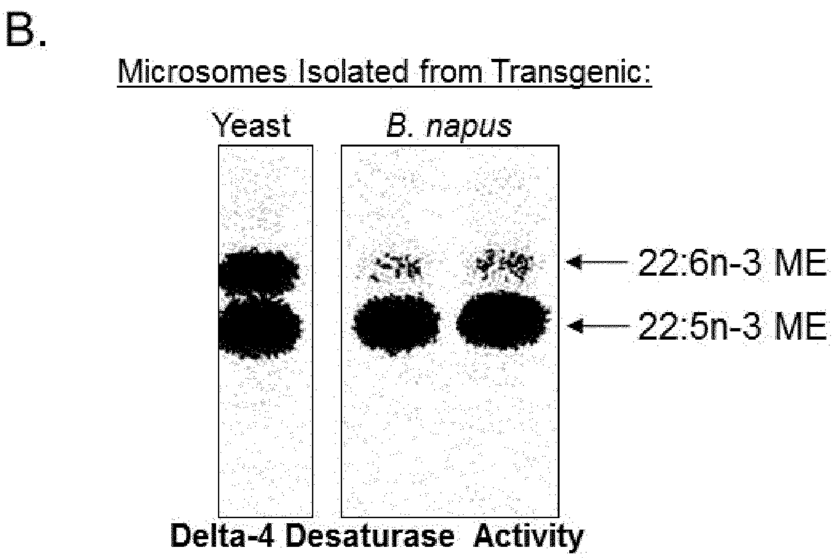

B.
Microsomes Isolated from Transgenic:
Yeast
B. napus
22:6n-3 ME
22:5n-3 ME
Delta-4 Desaturase Activity

Fig. 26

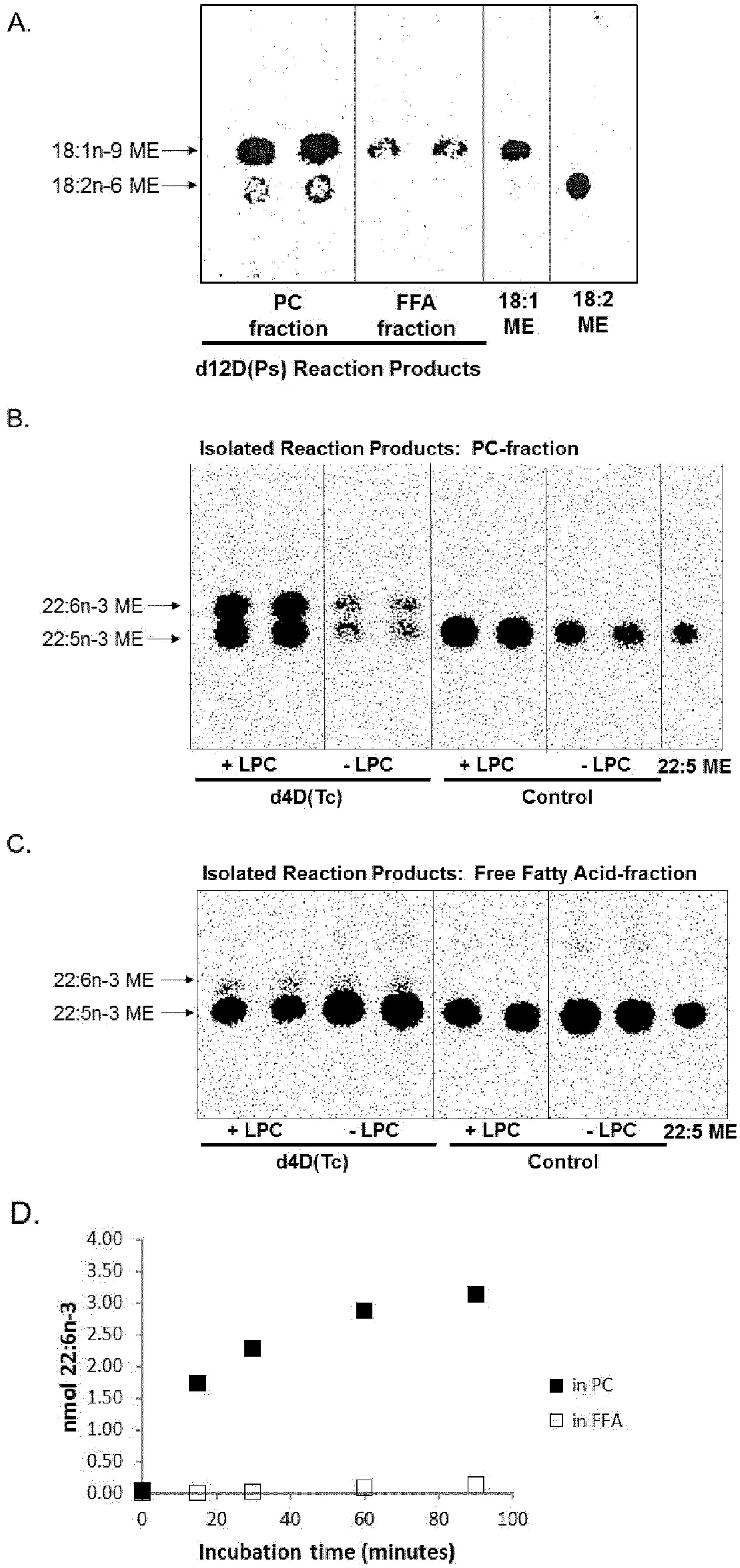
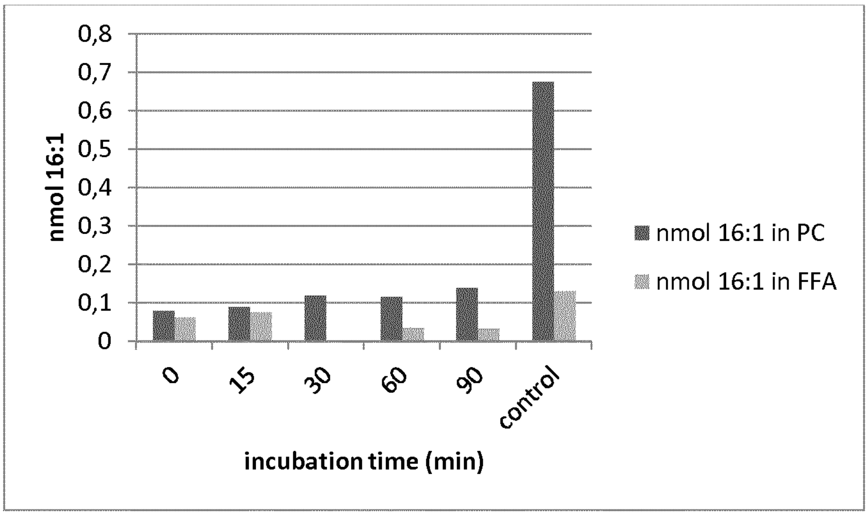
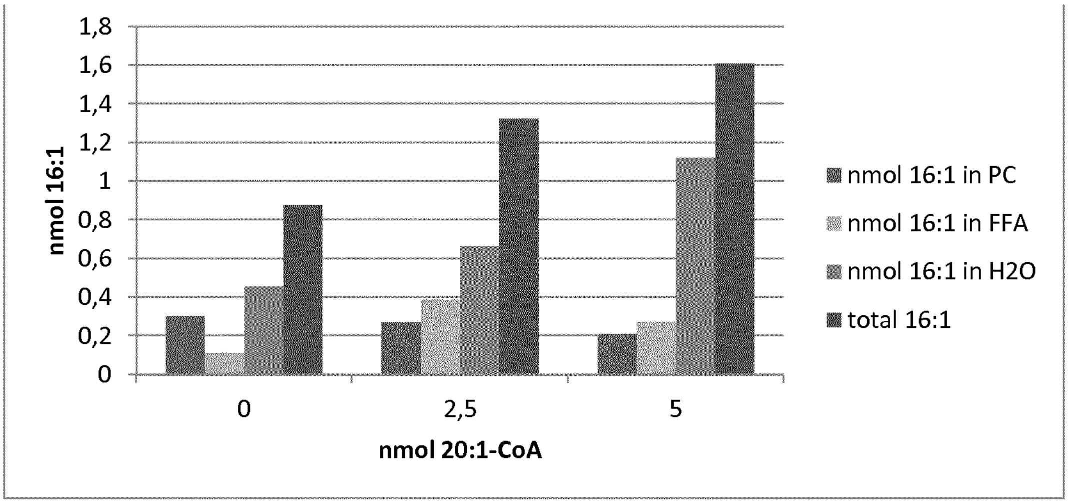

A.
18:1n-9 ME
18:2n-6 ME
PC fraction
FFA fraction
18:1 ME
18:2 ME
d12D(Ps) Reaction Products
B.
Isolated Reaction Products: PC-fraction
22:6n-3 ME
22:5n-3 ME
+ LPC
- LPC
+ LPC
- LPC
22:5 ME
d4D(Tc)
Control
C.
Isolated Reaction Products: Free Fatty Acid-fraction
22:6n-3 ME
22:5n-3 ME
+ LPC
- LPC
+ LPC
- LPC
22:5 ME
d4D(Tc)
Control
D.
nmol 22:6n-3
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
20
40
60
80
100
Incubation time (minutes)
in PC
in FFA

Fig. 27

A.


0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
nmol 16:1
0
15
30
60
90
control
incubation time (min)
nmol 16:1 in PC
nmol 16:1 in FFA

B.


1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
nmol 16:1
0
2,5
5
nmol 20:1-CoA
nmol 16:1 in PC
nmol 16:1 in FFA
nmol 16:1 in H2O
total 16:1

C.

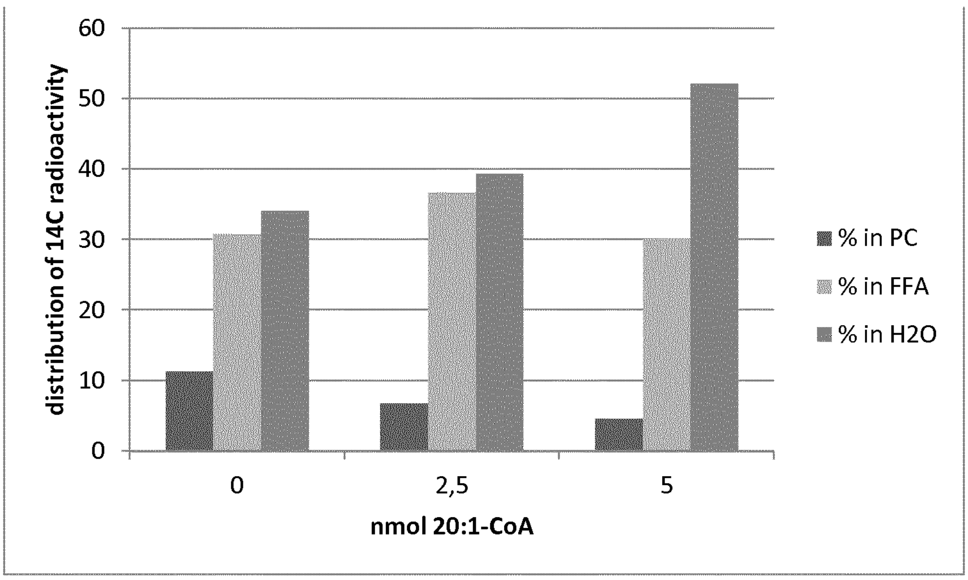

60
50
40
30
20
10
0
distribution of 14C radioactivity
0
2,5
5
nmol 20:1-CoA
% in PC
% in FFA
% in H2O

Fig. 28

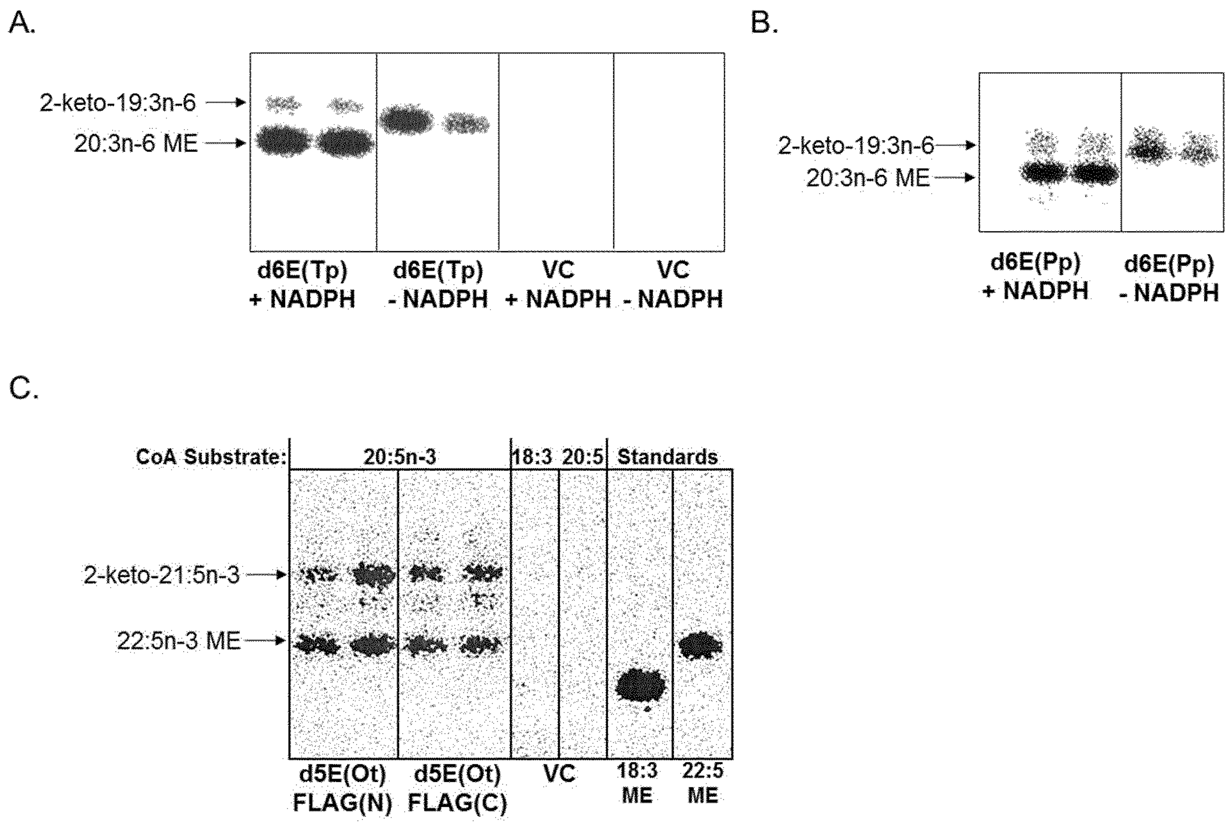
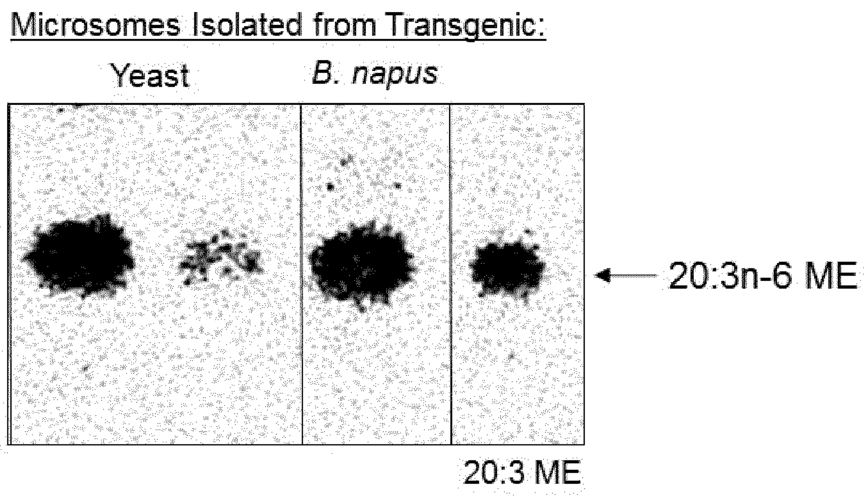

A.
2-keto-19:3n-6
20:3n-6 ME
d6E(Tp) + NADPH
d6E(Tp) - NADPH
VC + NADPH
VC - NADPH
B.
2-keto-19:3n-6
20:3n-6 ME
d6E(Pp) + NADPH
d6E(Pp) - NADPH
C.
CoA Substrate:
20:5n-3
18:3
20:5
Standards
2-keto-21:5n-3
22:5n-3 ME
d5E(Ot) FLAG(N)
d5E(Ot) FLAG(C)
VC
18:3 ME
22:5 ME

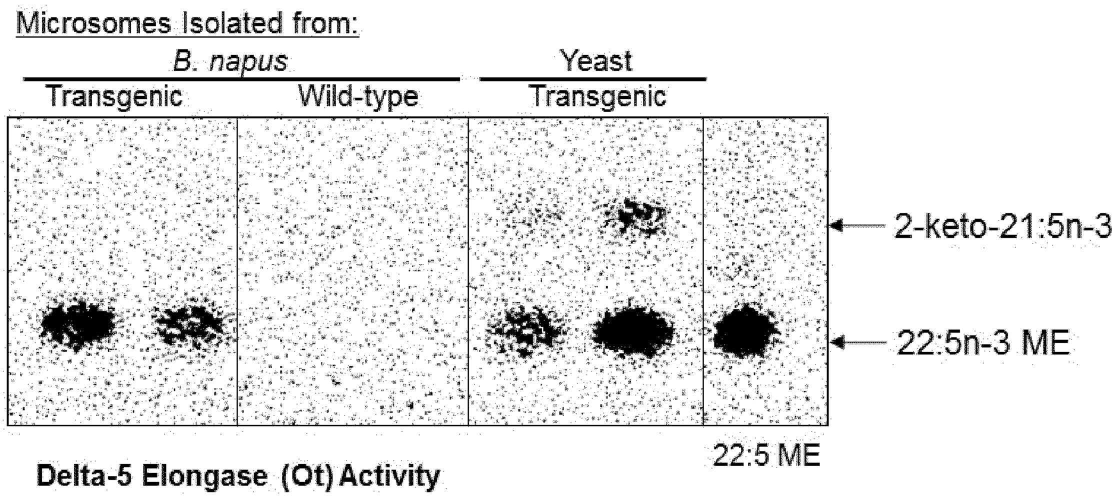
Fig. 29

A.



Delta-6 Elongase Activity

B.



Delta-5 Elongase (Ot) Activity

Figure 30

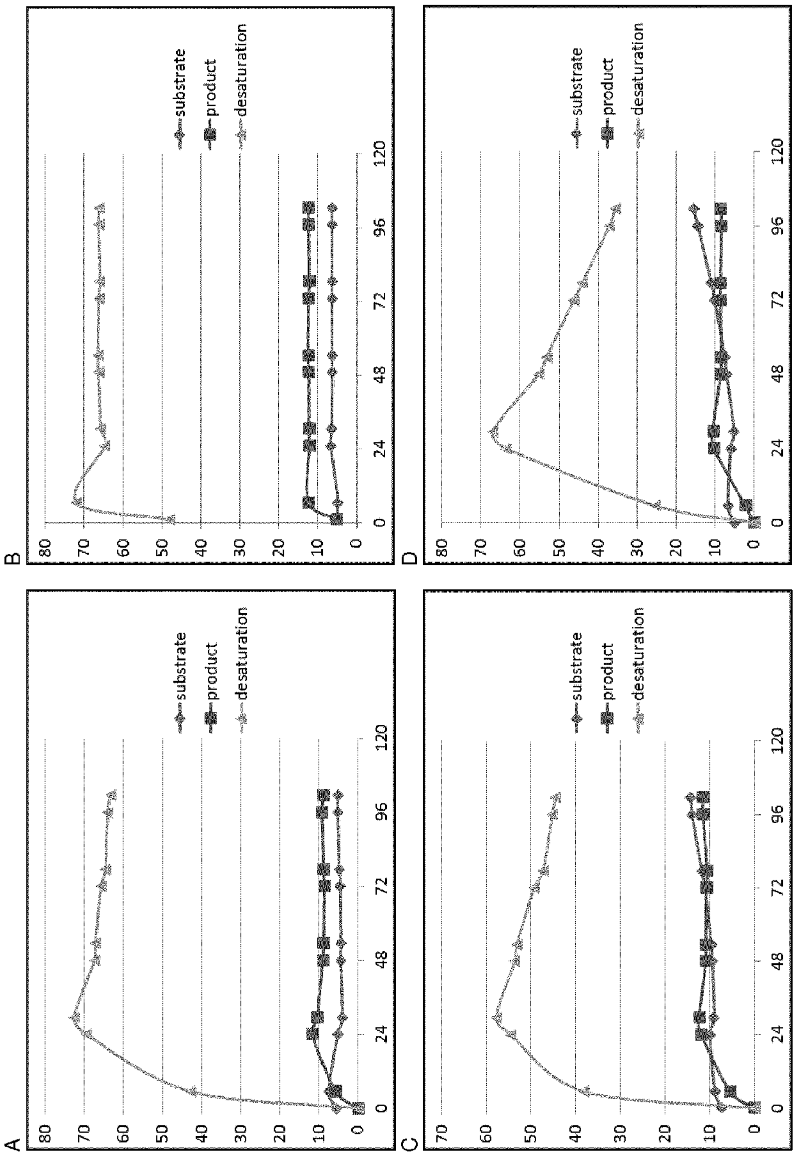

A
B
C
D
substrate
product
desaturation
0
24
48
72
96
120
0
10
20
30
40
50
60
70
80

Figure 31

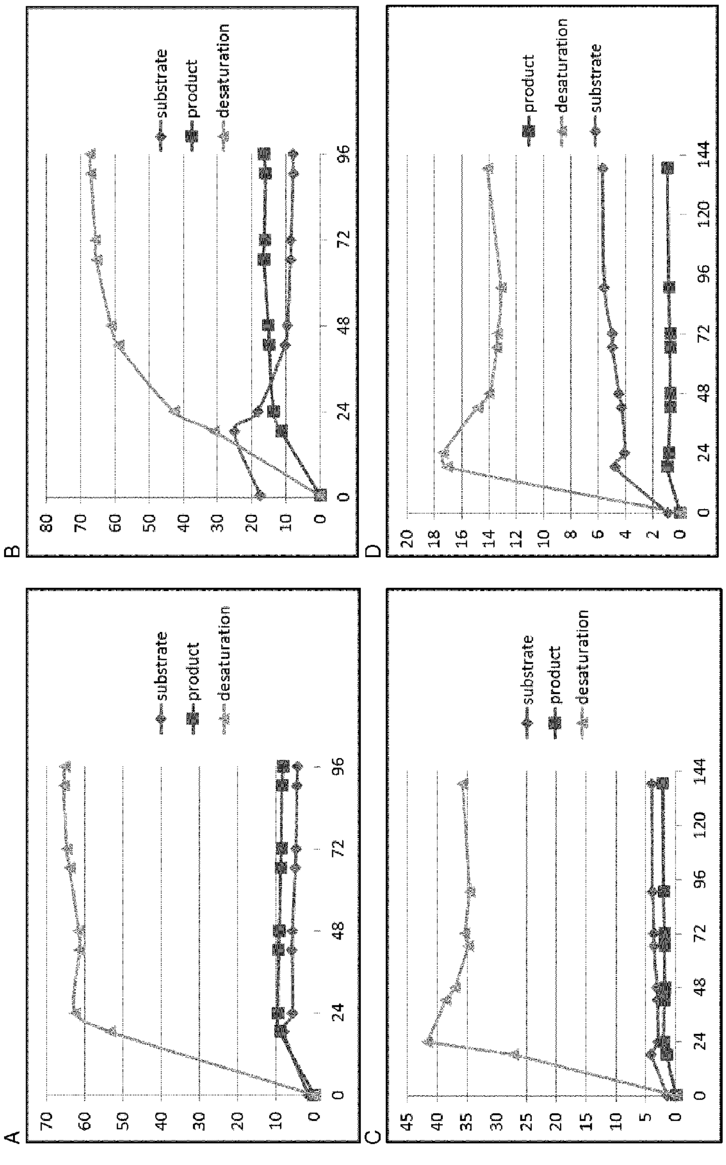

A
substrate
product
desaturation
B
substrate
product
desaturation
C
substrate
product
desaturation
D
product
desaturation
substrate

Figure 31 cont.

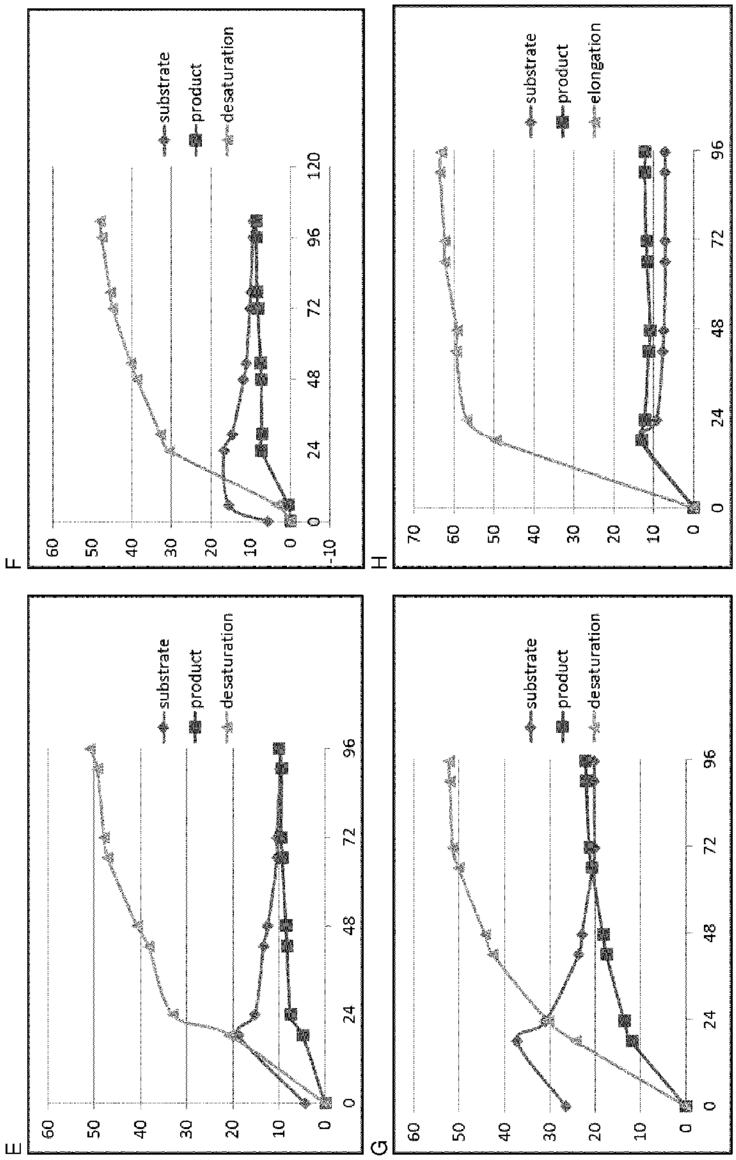
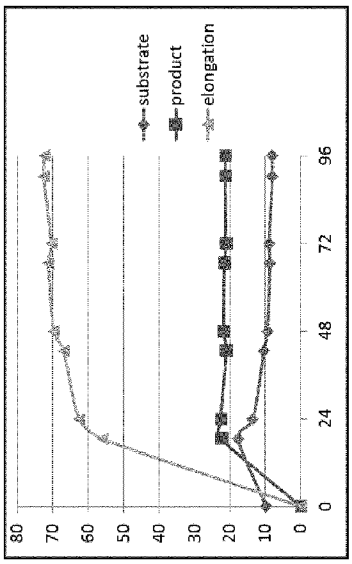


Figure 31 cont.

I



J

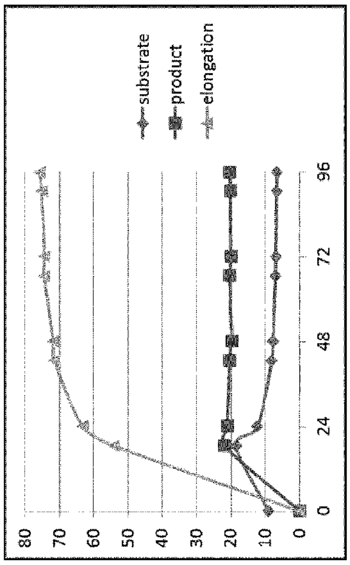


Fig. 32

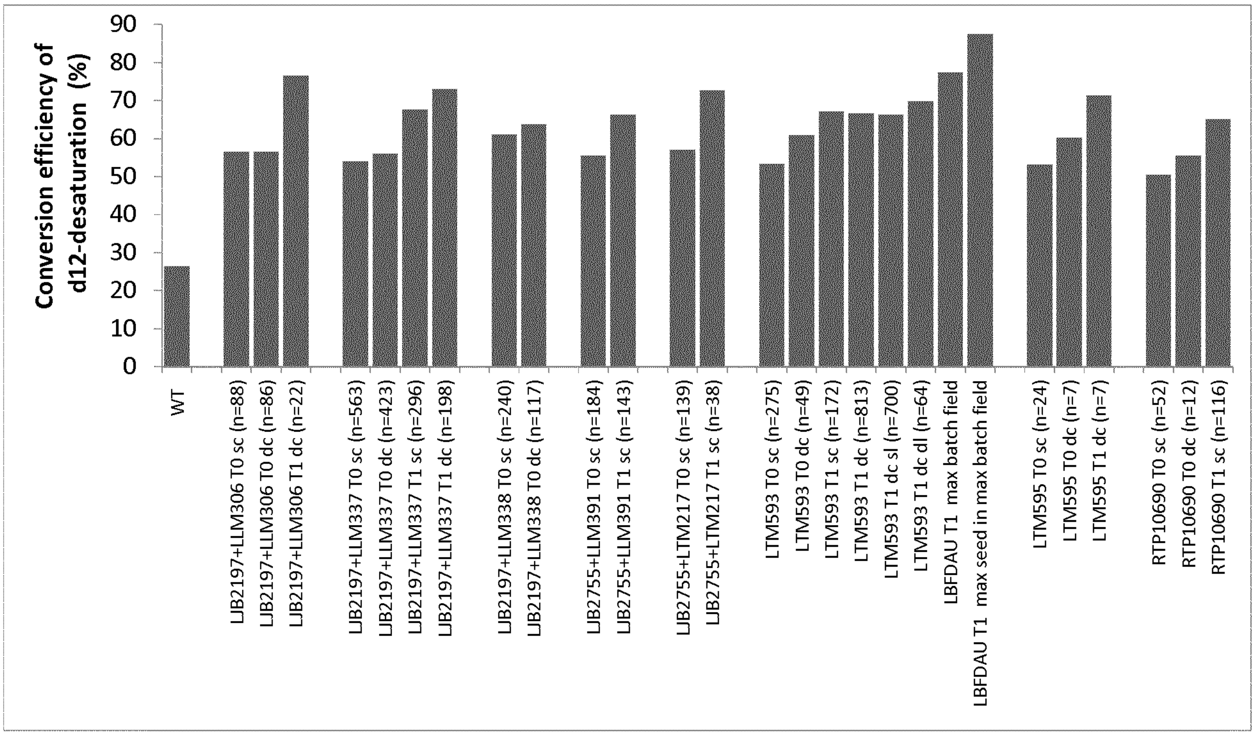

Conversion efficiency of d12-desaturation (%)
0
10
20
30
40
50
60
70
80
90
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 33

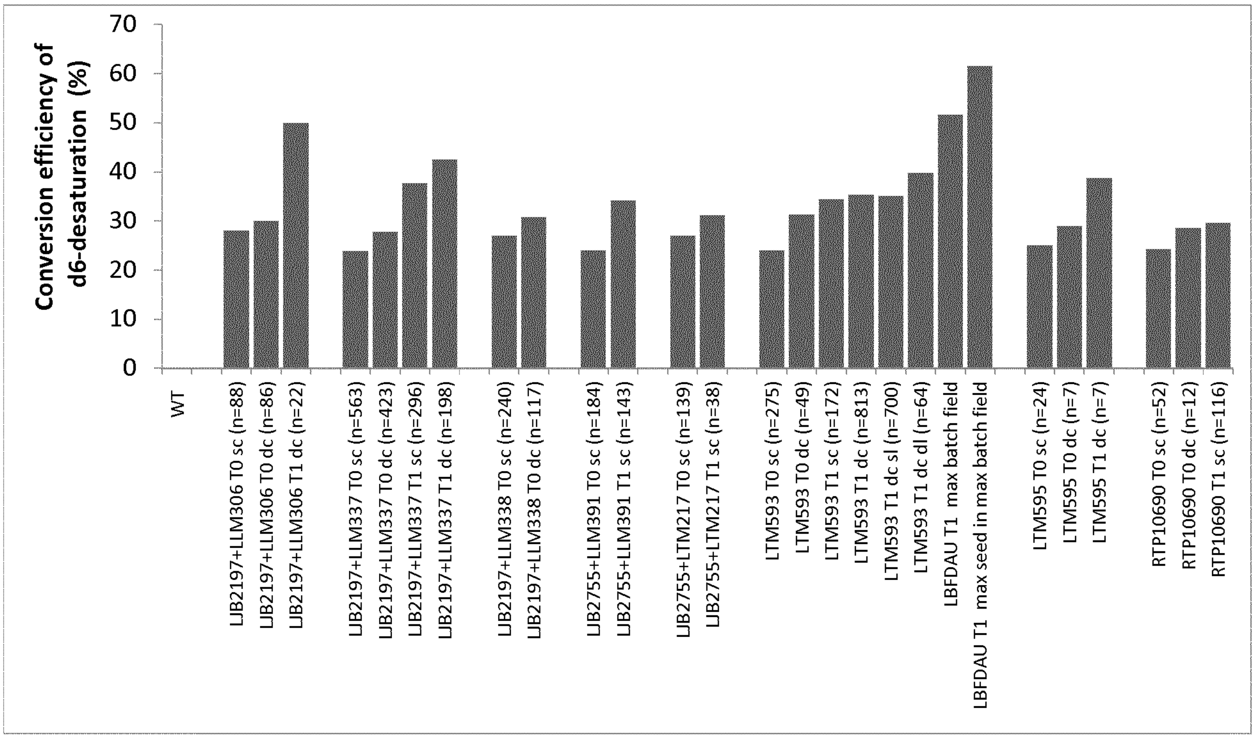

Conversion efficiency of d6-desaturation (%)
70
60
50
40
30
20
10
0
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 34

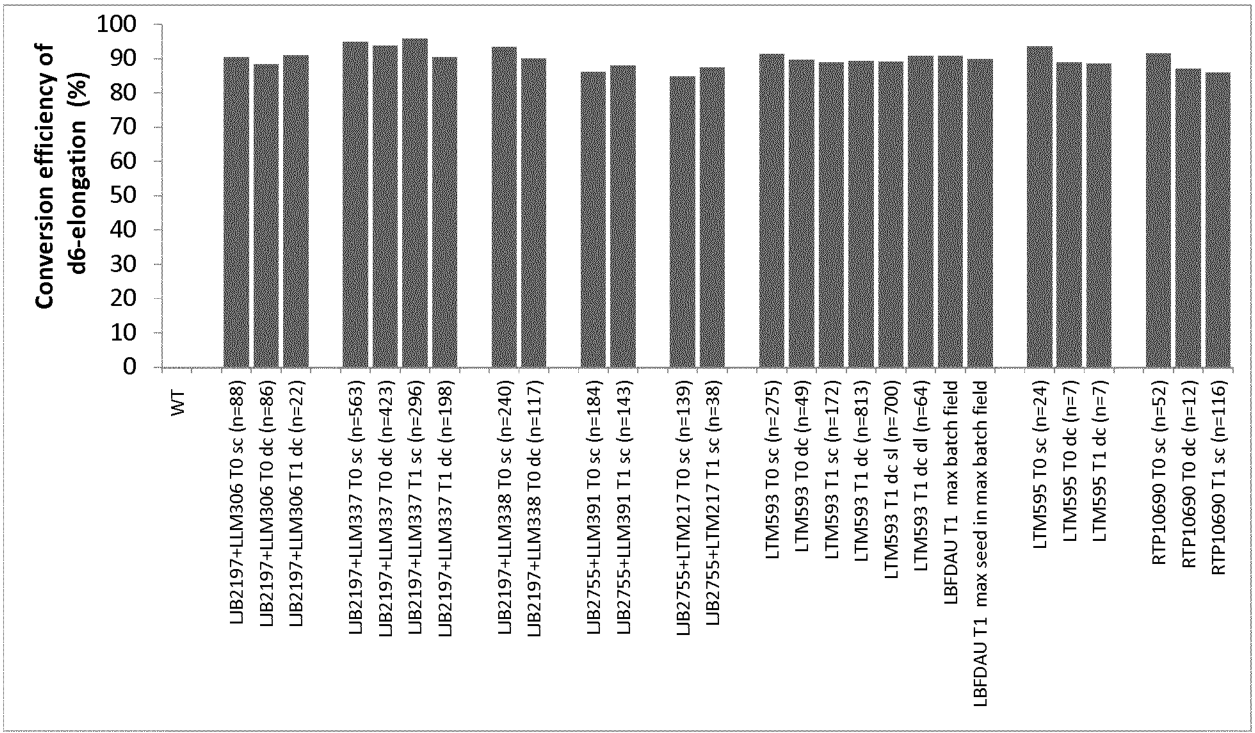

Conversion efficiency of d6-elongation (%)
100
90
80
70
60
50
40
30
20
10
0
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 35

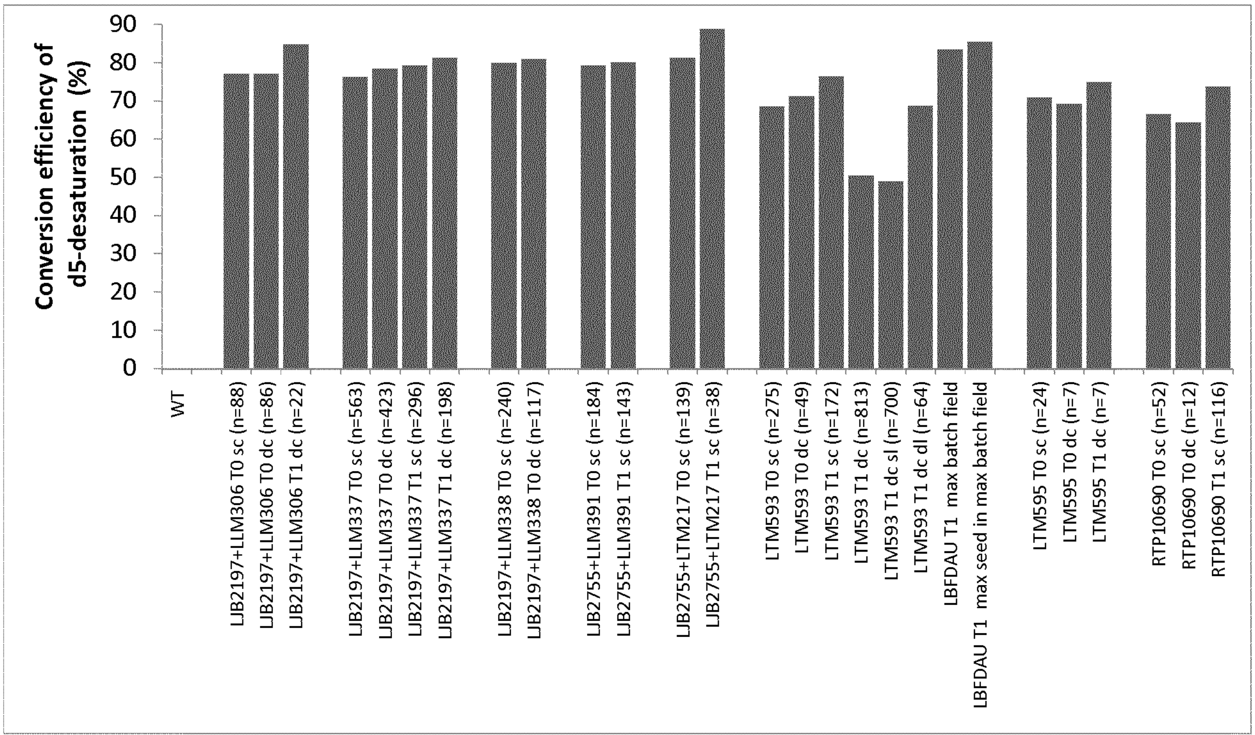

Conversion efficiency of d5-desaturation (%)
90
80
70
60
50
40
30
20
10
0
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 36

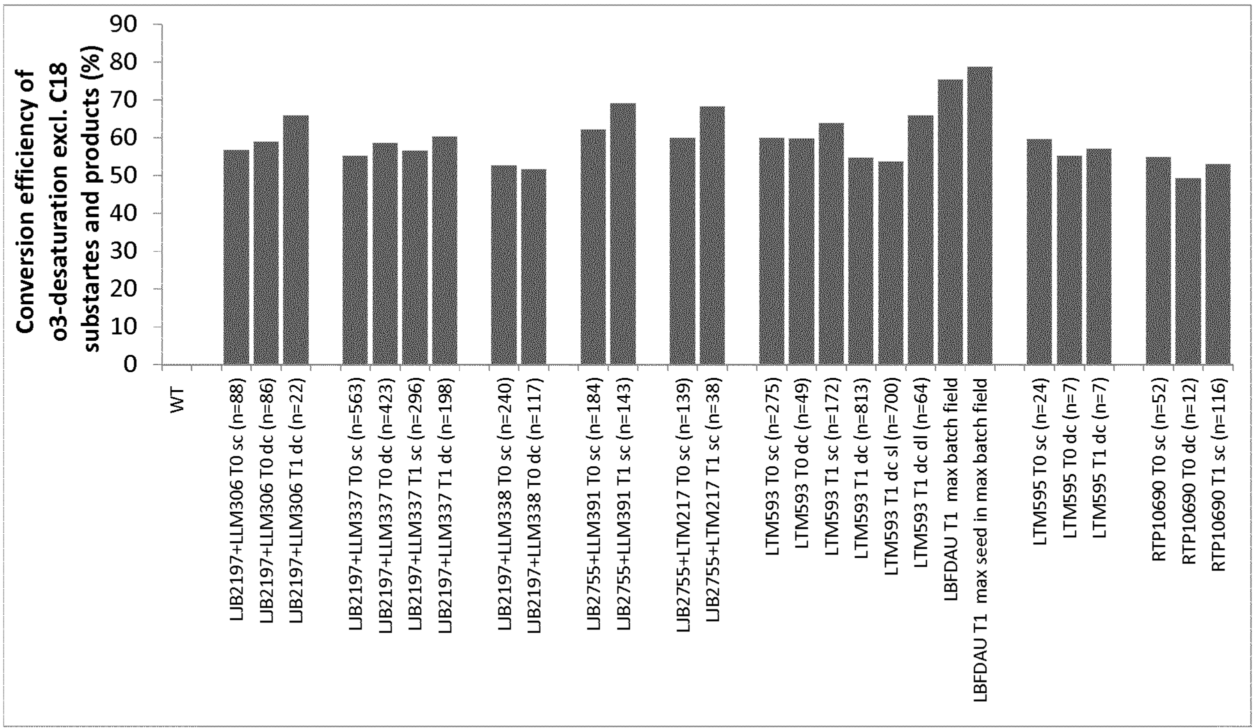

Conversion efficiency of o3-desaturation excl. C18 substartes and products (%)
0
10
20
30
40
50
60
70
80
90
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 37

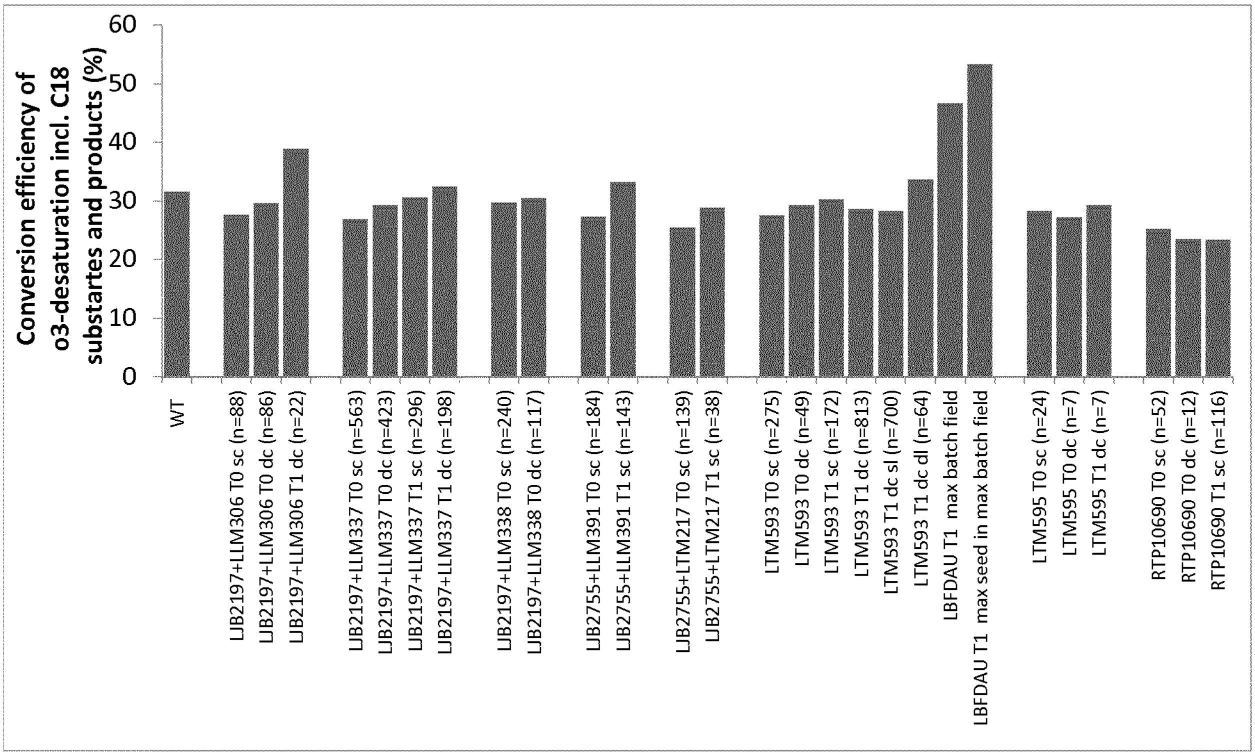

Conversion efficiency of o3-desaturation incl. C18 substartes and products (%)
60
50
40
30
20
10
0
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 38

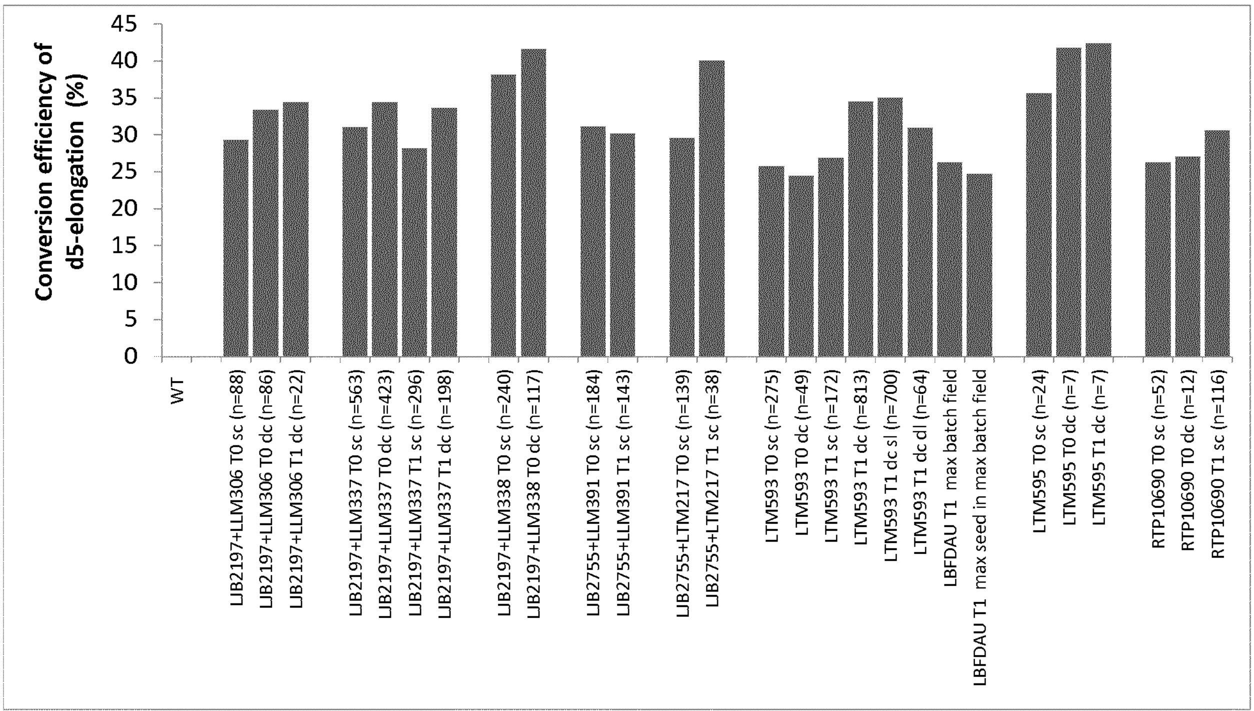

Conversion efficiency of d5-elongation (%)
45
40
35
30
25
20
15
10
5
0
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 39

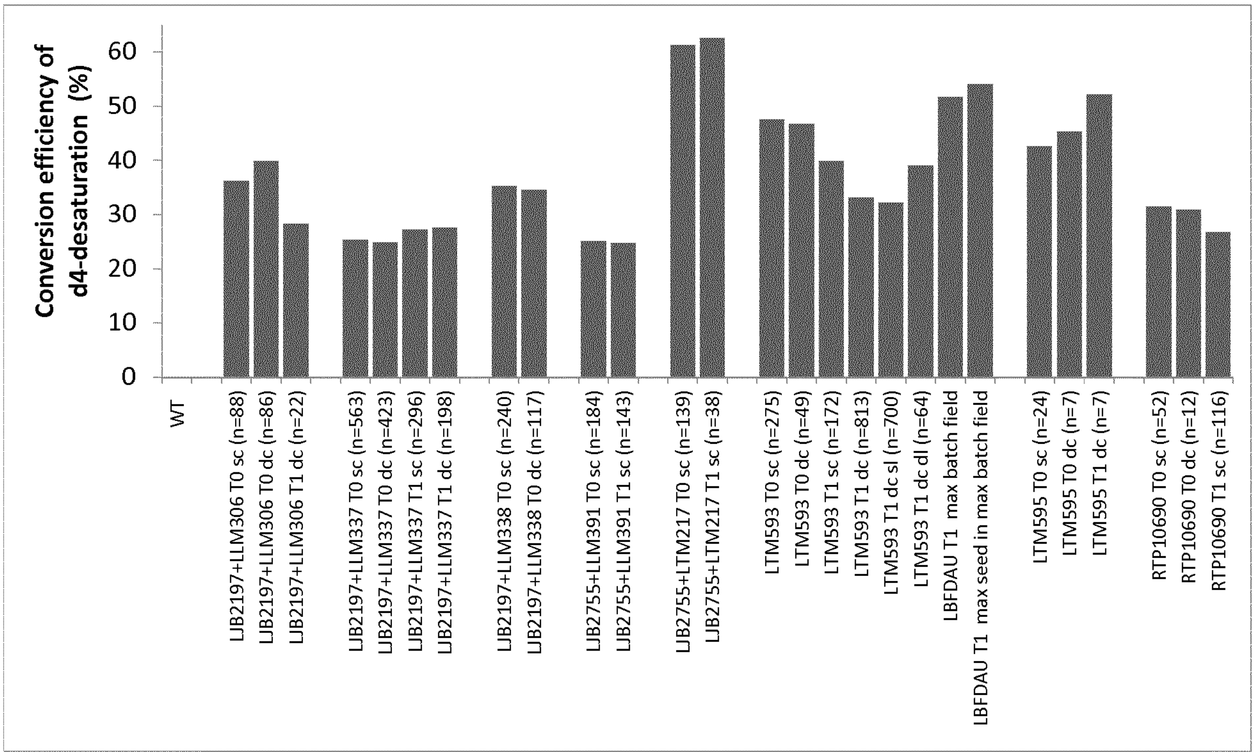

Conversion efficiency of d4-desaturation (%)
0
10
20
30
40
50
60
WT
LJB2197+LLM306 T0 sc (n=88)
LJB2197+LLM306 T0 dc (n=86)
LJB2197+LLM306 T1 dc (n=22)
LJB2197+LLM337 T0 sc (n=563)
LJB2197+LLM337 T0 dc (n=423)
LJB2197+LLM337 T1 sc (n=296)
LJB2197+LLM337 T1 dc (n=198)
LJB2197+LLM338 T0 sc (n=240)
LJB2197+LLM338 T0 dc (n=117)
LJB2755+LLM391 T0 sc (n=184)
LJB2755+LLM391 T1 sc (n=143)
LJB2755+LTM217 T0 sc (n=139)
LJB2755+LTM217 T1 sc (n=38)
LTM593 T0 sc (n=275)
LTM593 T0 dc (n=49)
LTM593 T1 sc (n=172)
LTM593 T1 dc (n=813)
LTM593 T1 dc sl (n=700)
LTM593 T1 dc dl (n=64)
LBFDAU T1 max batch field
LBFDAU T1 max seed in max batch field
LTM595 T0 sc (n=24)
LTM595 T0 dc (n=7)
LTM595 T1 dc (n=7)
RTP10690 T0 sc (n=52)
RTP10690 T0 dc (n=12)
RTP10690 T1 sc (n=116)

Fig. 40

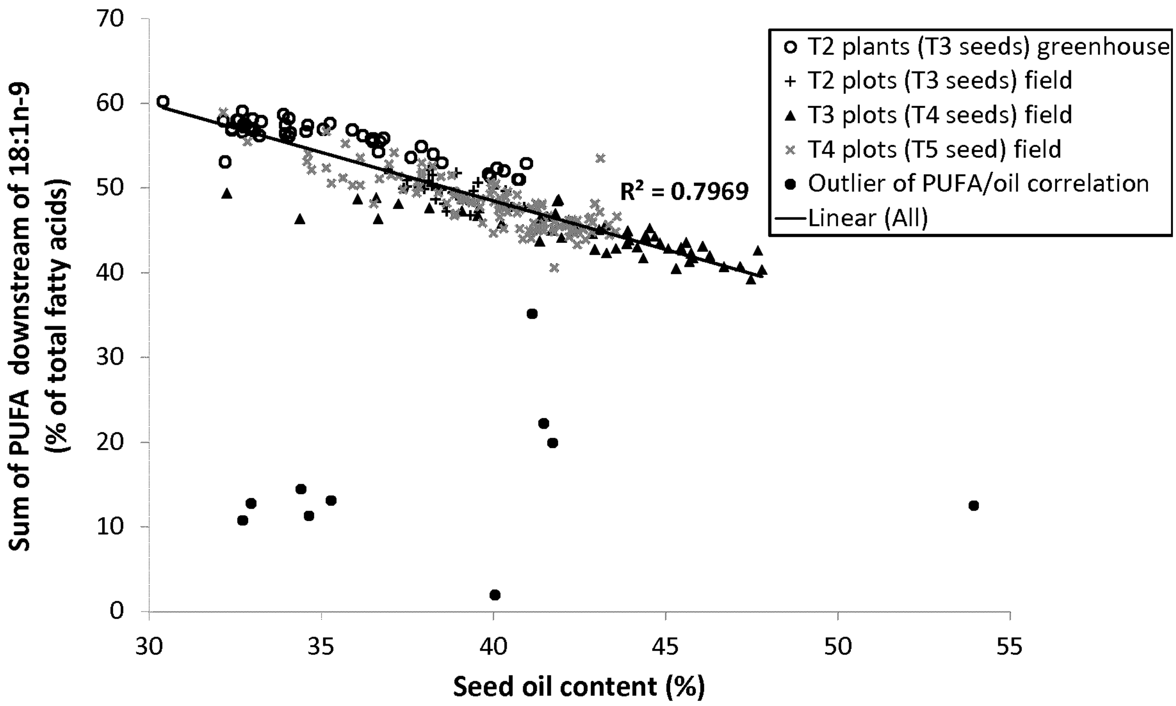

T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)
R² = 0.7969
Sum of PUFA downstream of 18:1n-9 (% of total fatty acids)
Seed oil content (%)
70
60
50
40
30
20
10
0
30
35
40
45
50
55

Fig. 41

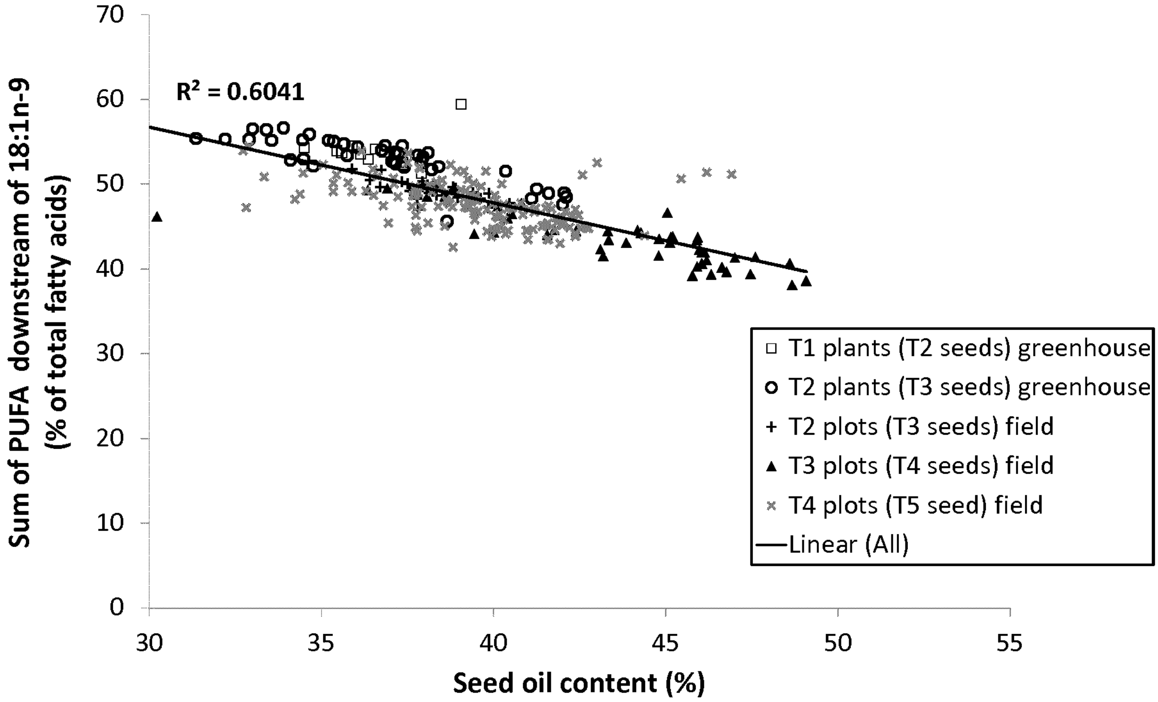

R² = 0.6041
Sum of PUFA downstream of 18:1n-9
(% of total fatty acids)
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)
0
10
20
30
40
50
60
70
30
35
40
45
50
55

Fig. 42

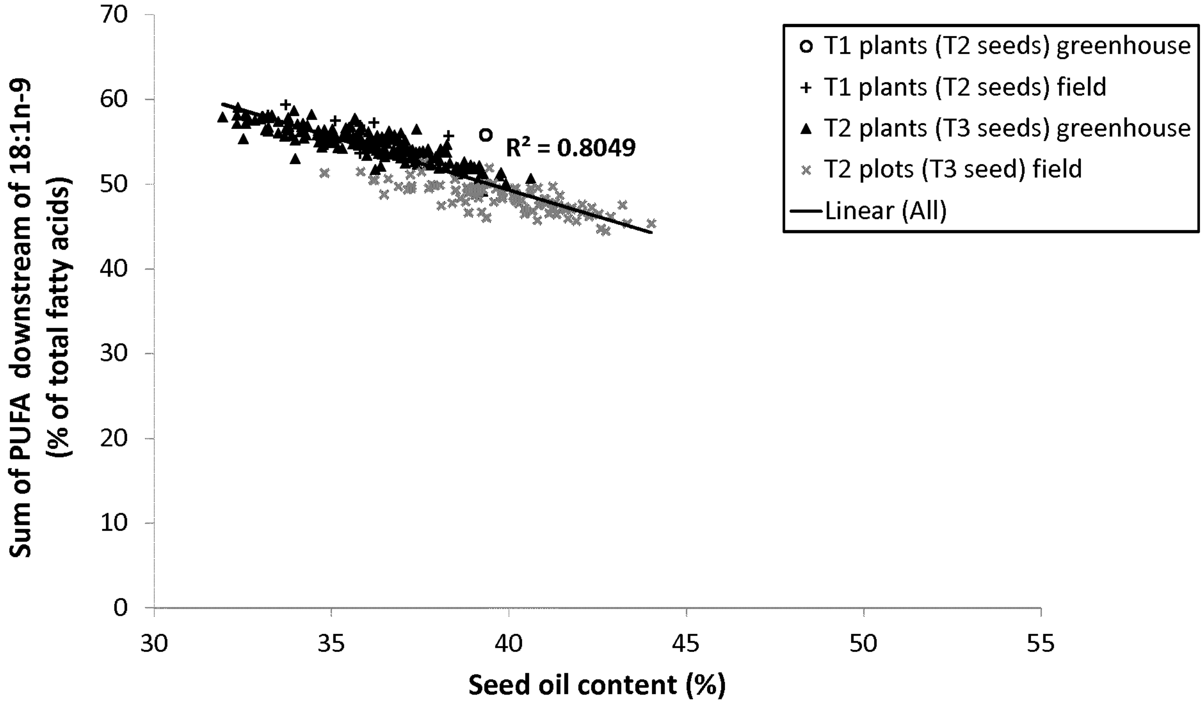

70
60
50
40
30
20
10
0
30
35
40
45
50
55
Sum of PUFA downstream of 18:1n-9
(% of total fatty acids)
Seed oil content (%)
R² = 0.8049
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 43

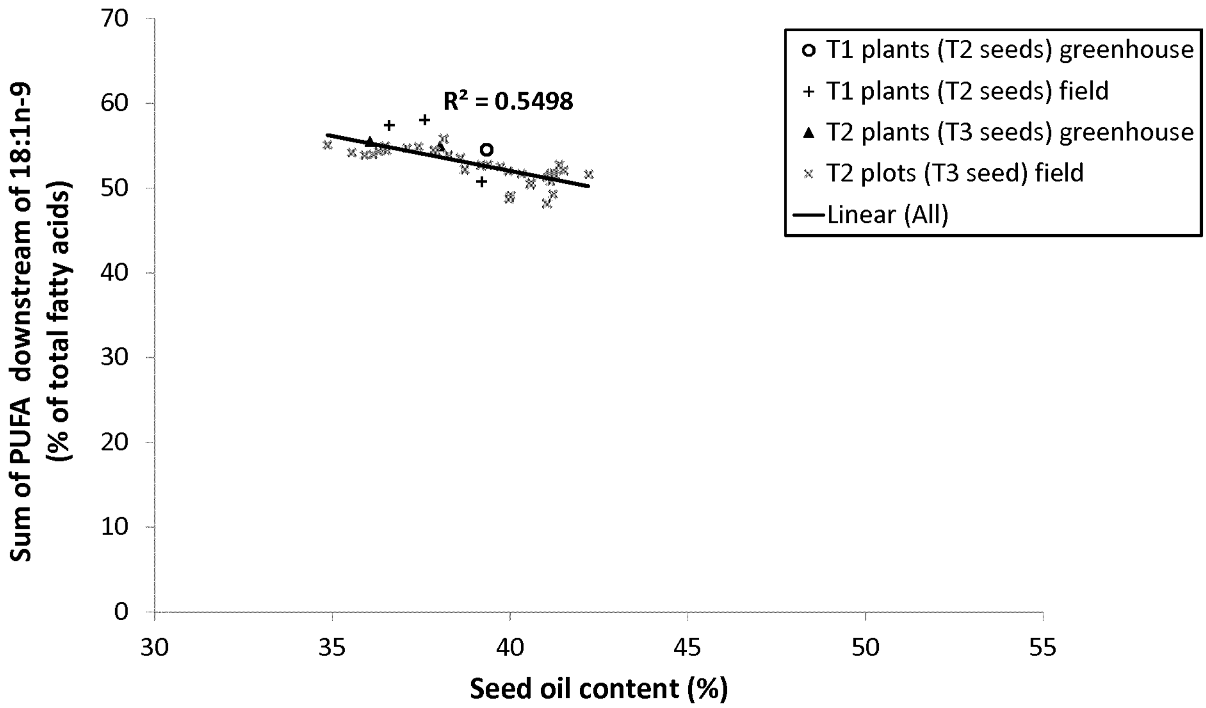

R² = 0.5498
Sum of PUFA downstream of 18:1n-9
(% of total fatty acids)
Seed oil content (%)
0
10
20
30
40
50
60
70
30
35
40
45
50
55
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 44

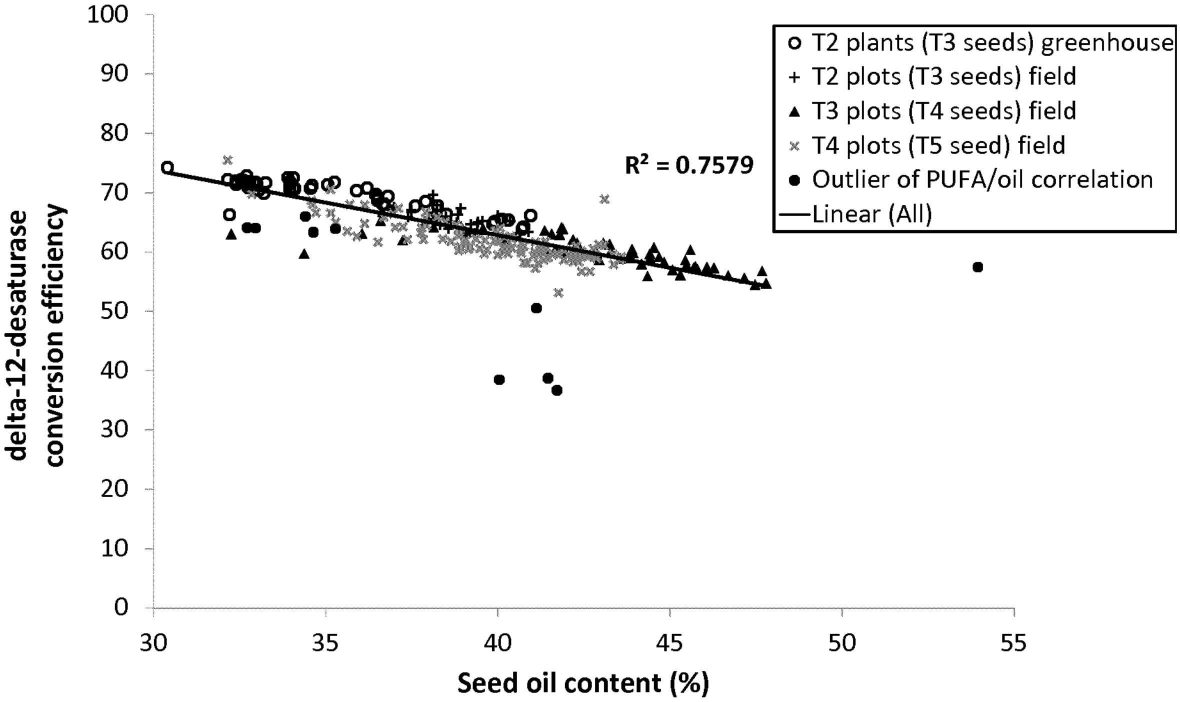

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-12-desaturase conversion efficiency
Seed oil content (%)
$R^2 = 0.7579$
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)

Fig. 45

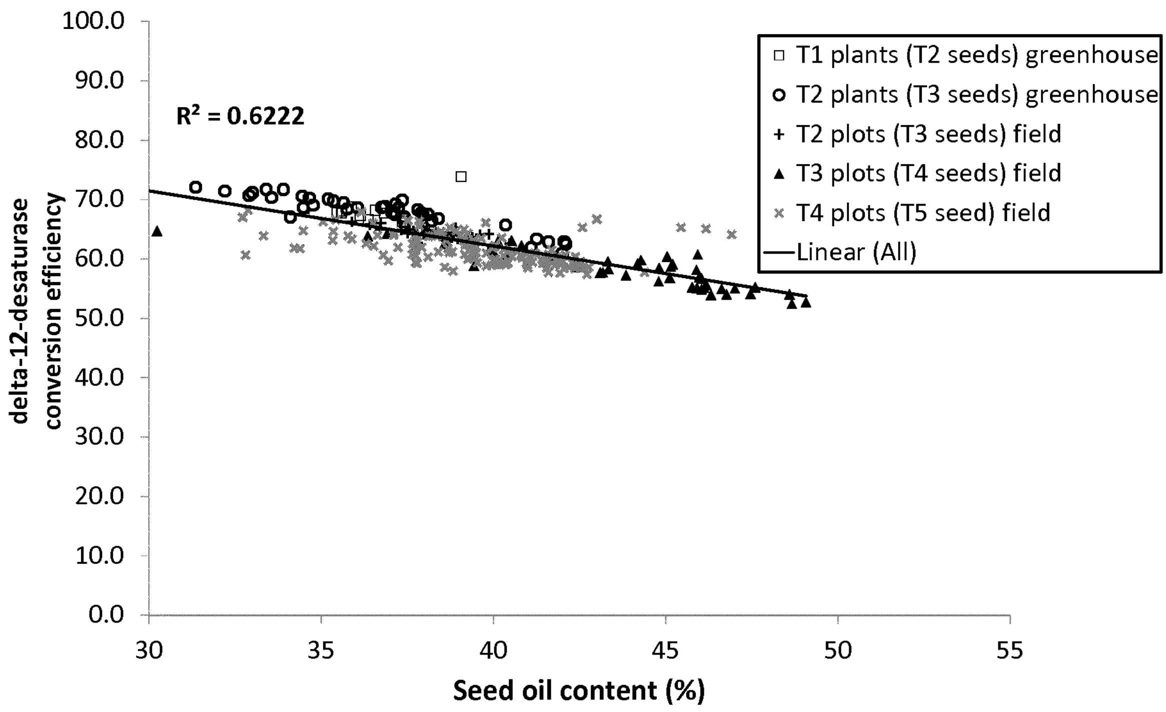

100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
30
35
40
45
50
55
R² = 0.6222
delta-12-desaturase conversion efficiency
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 46

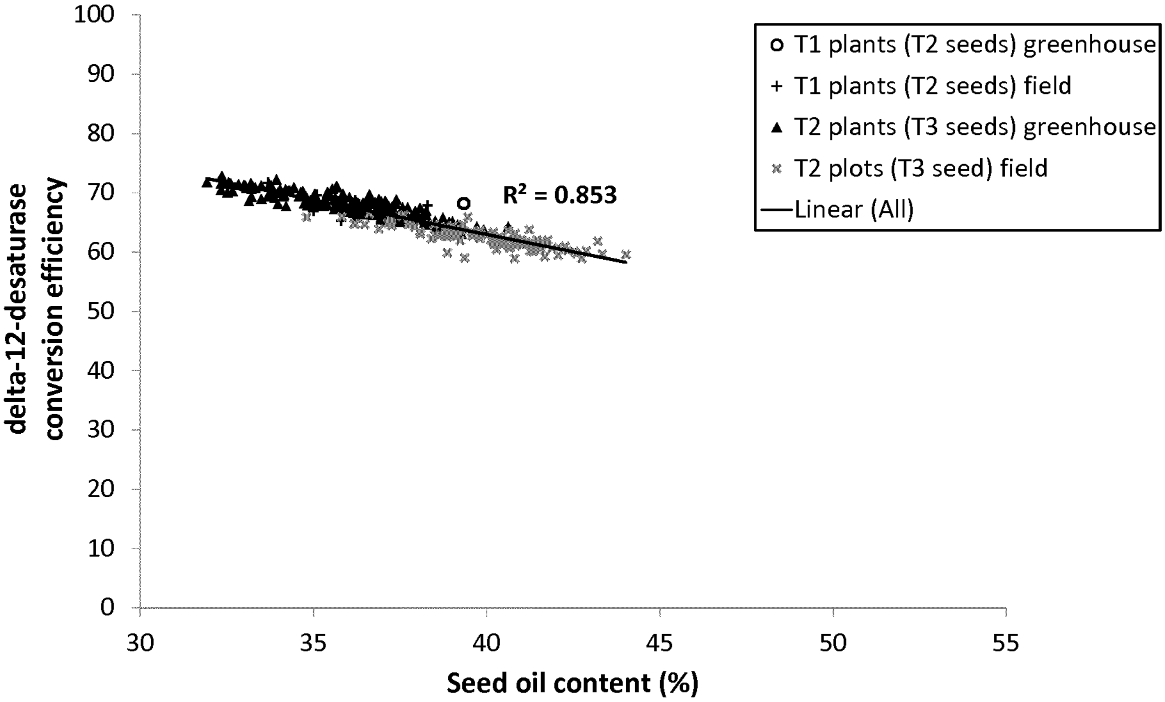

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-12-desaturase conversion efficiency
Seed oil content (%)
R^2 = 0.853
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 47

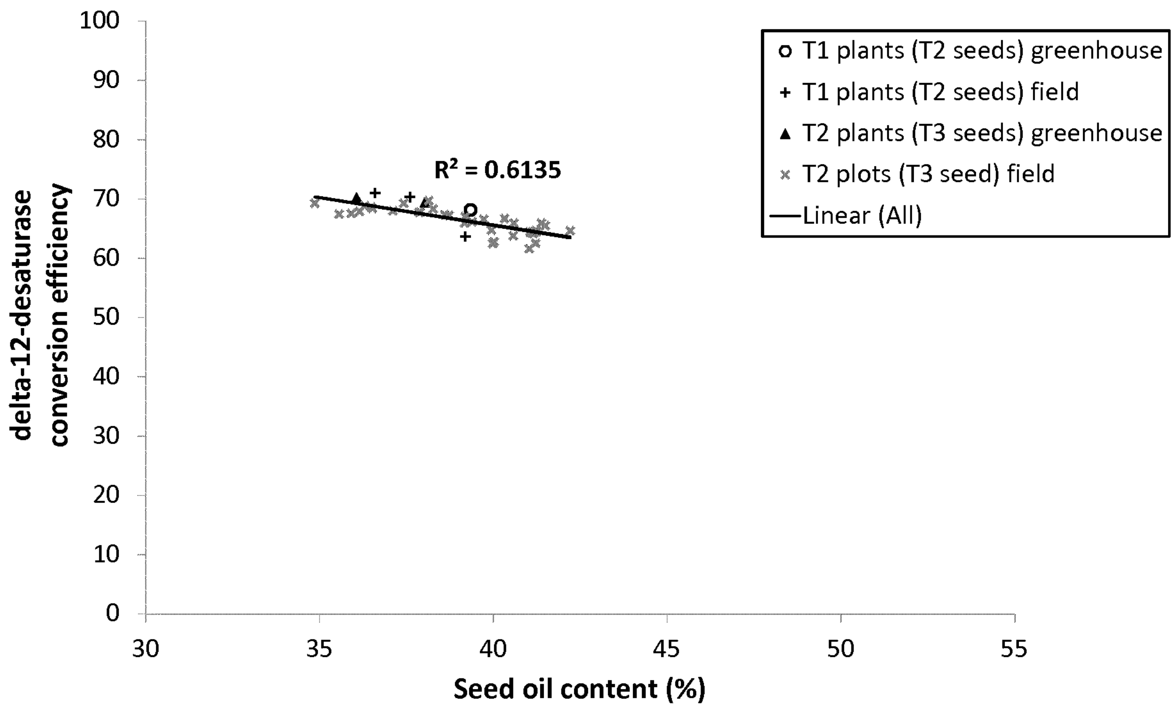

100
90
80
70
60
50
40
30
20
10
0
delta-12-desaturase conversion efficiency
R^2 = 0.6135
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)
30
35
40
45
50
55
Seed oil content (%)

Fig. 48

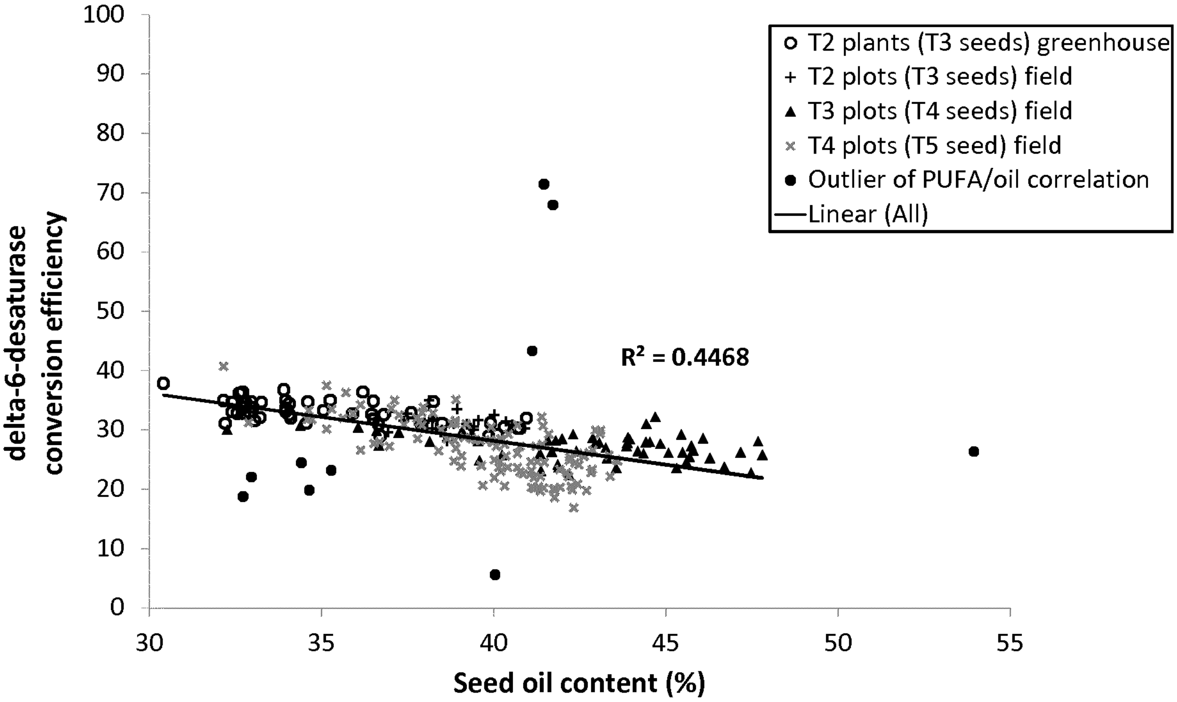

T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)
$R^2 = 0.4468$
delta-6-desaturase conversion efficiency
Seed oil content (%)
100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55

Fig. 49

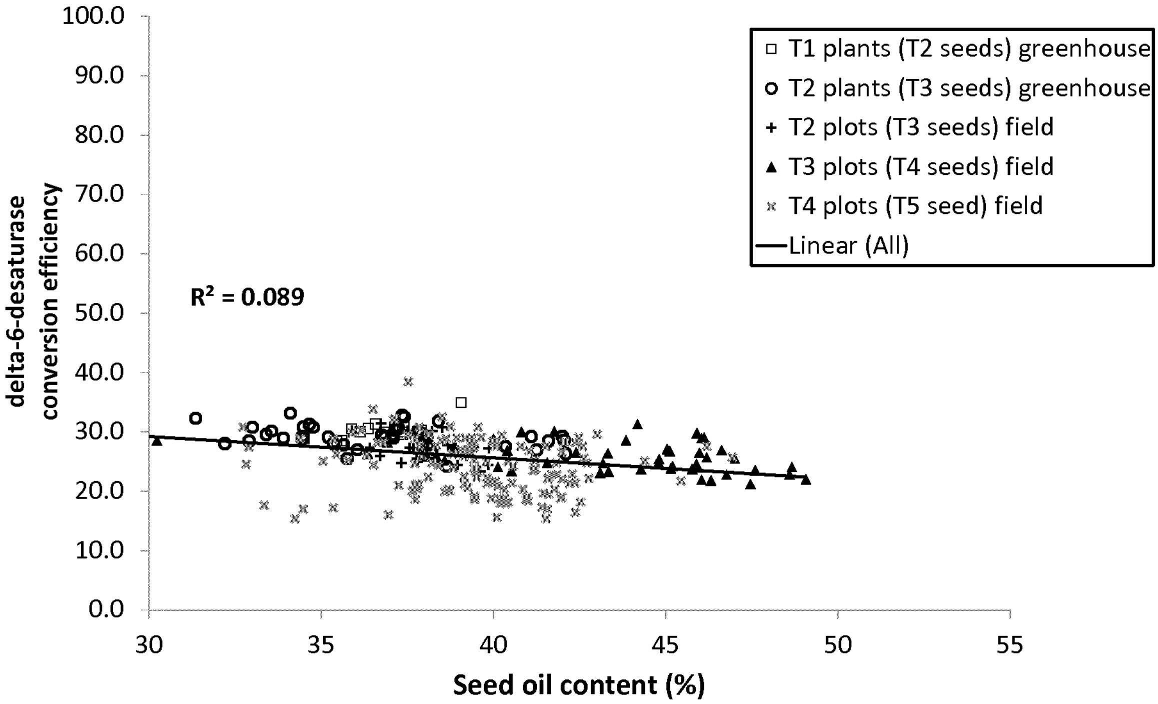

100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
delta-6-desaturase conversion efficiency
30
35
40
45
50
55
Seed oil content (%)
R² = 0.089
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 50

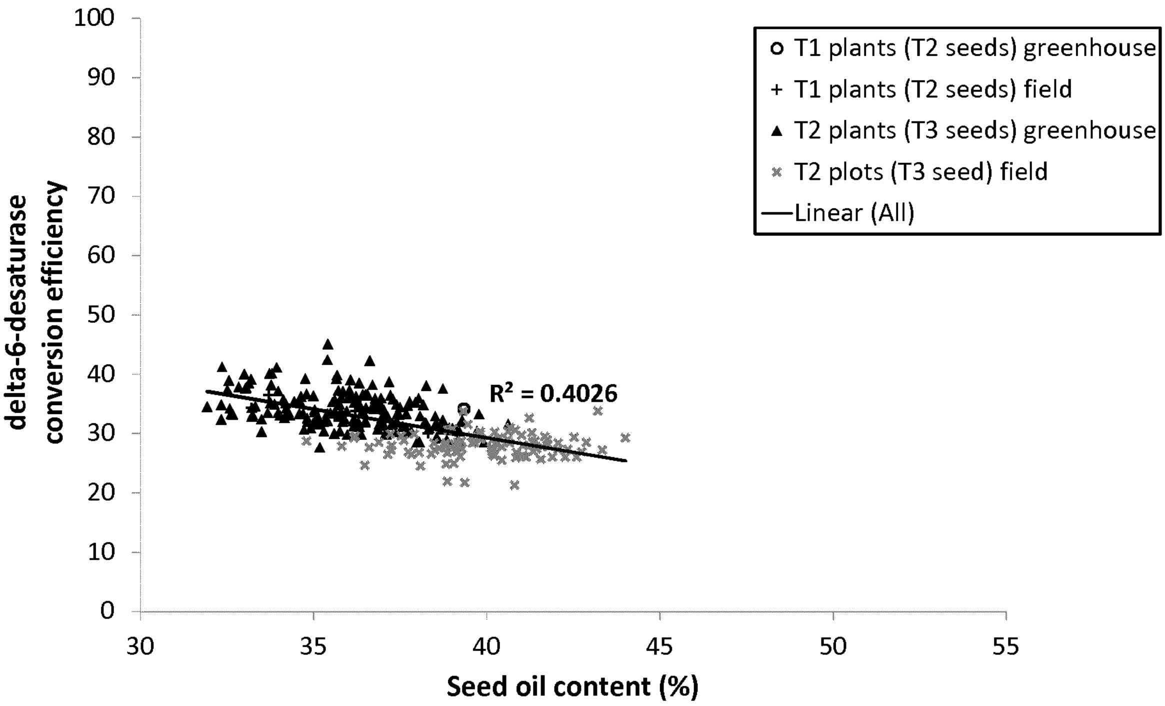

100
90
80
70
60
50
40
30
20
10
0
delta-6-desaturase conversion efficiency
30
35
40
45
50
55
Seed oil content (%)
R² = 0.4026
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 51

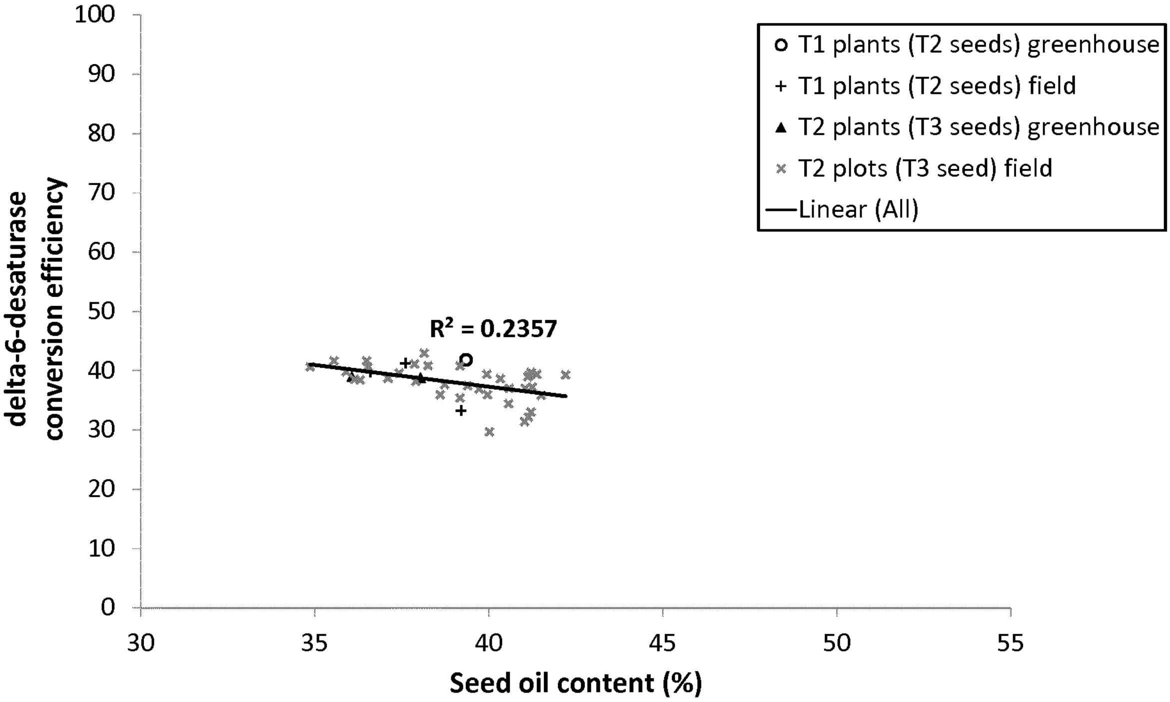

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-6-desaturase conversion efficiency
Seed oil content (%)
R² = 0.2357
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 52

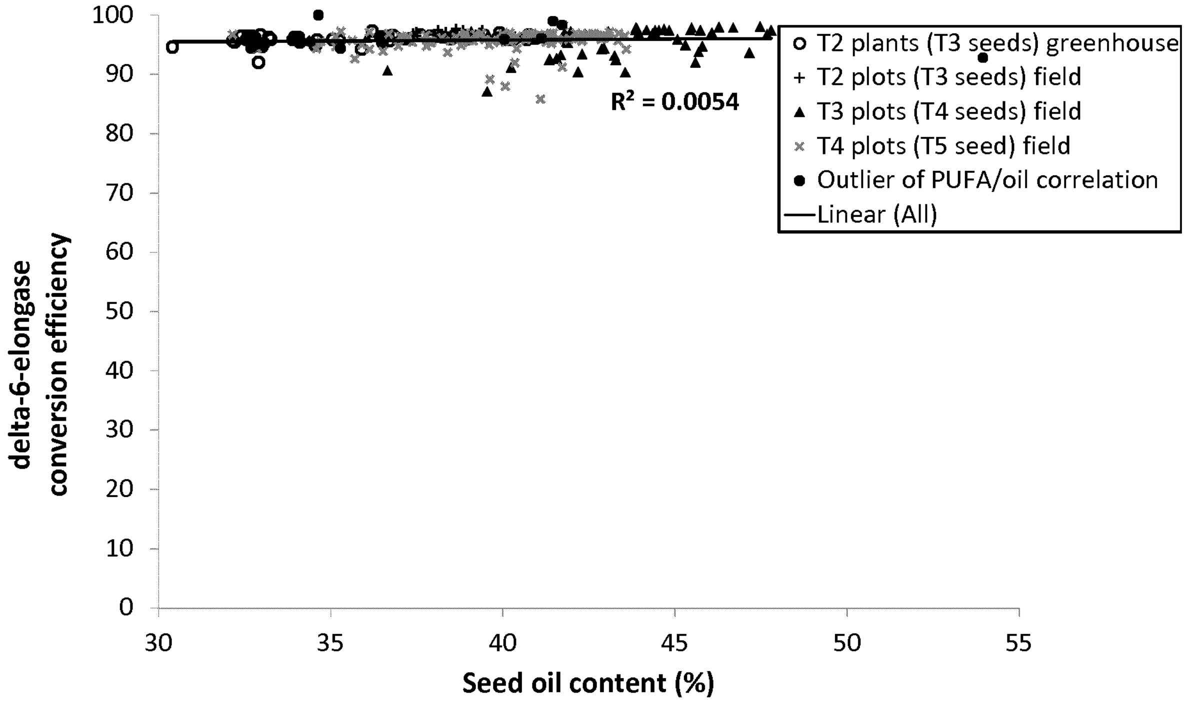

delta-6-elongase conversion efficiency
Seed oil content (%)
R² = 0.0054
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)
100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55

Figure 53

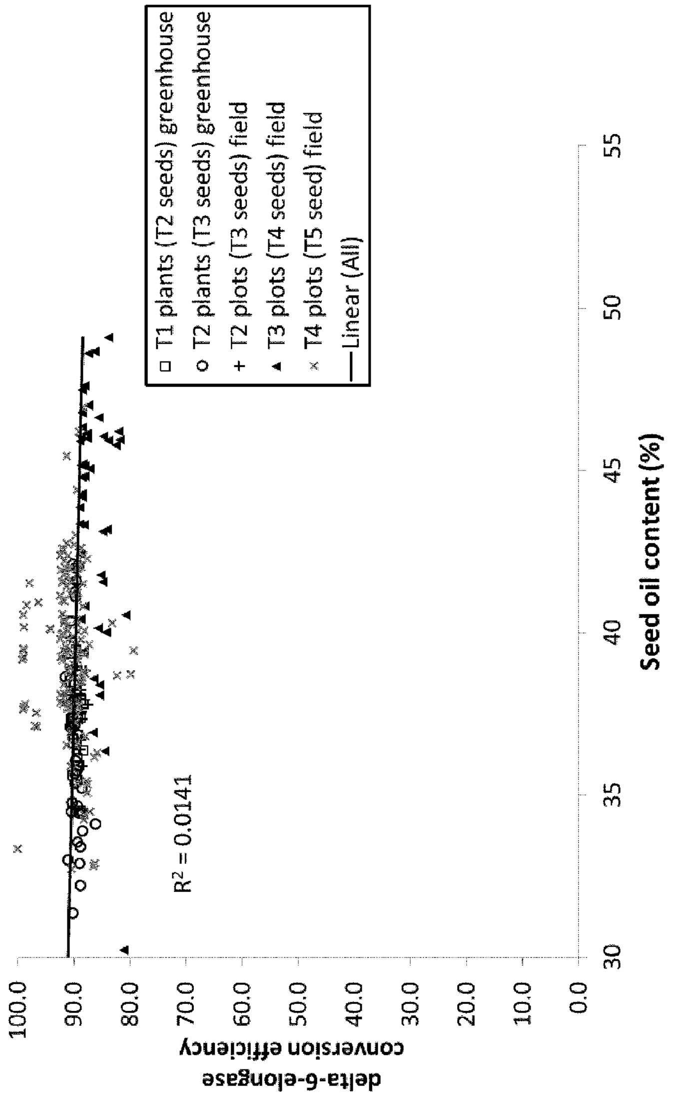

delta-6-elongase conversion efficiency
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
30
35
40
45
50
55
Seed oil content (%)
$R^2 = 0.0141$
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 54

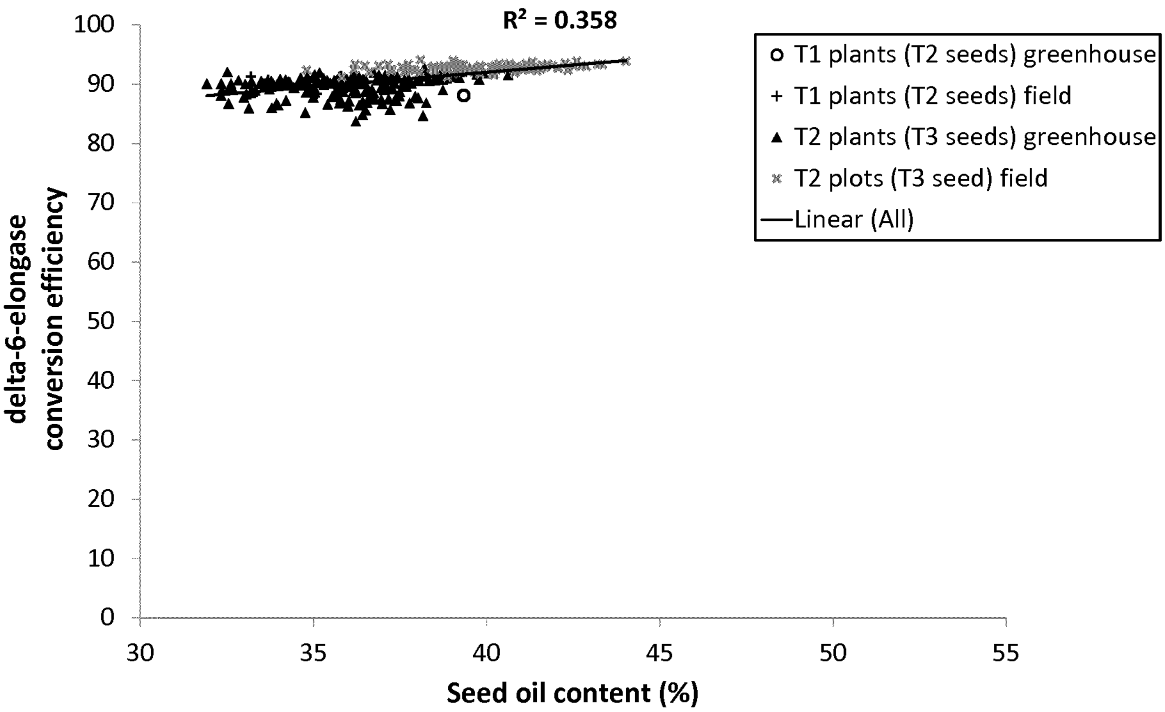

R² = 0.358
100
90
80
70
60
50
40
30
20
10
0
delta-6-elongase conversion efficiency
30
35
40
45
50
55
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 55

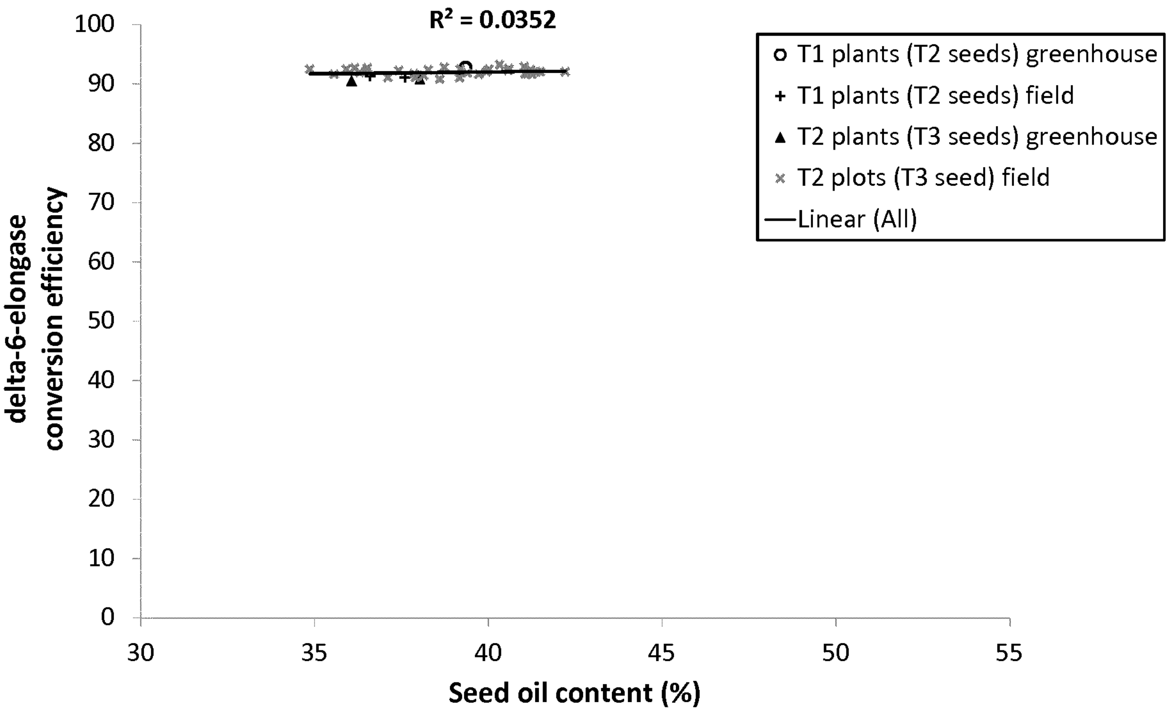

R² = 0.0352
100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-6-elongase conversion efficiency
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 56

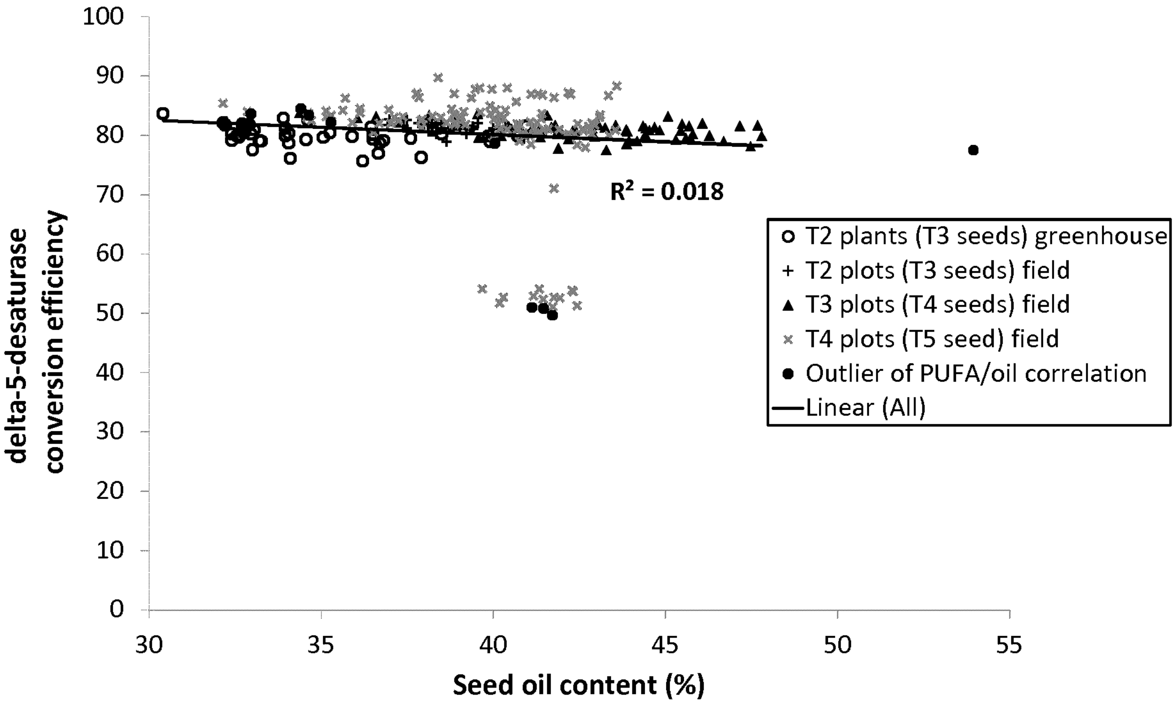

100
90
80
70
60
50
40
30
20
10
0
delta-5-desaturase conversion efficiency
30
35
40
45
50
55
Seed oil content (%)
R² = 0.018
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)

Figure 57

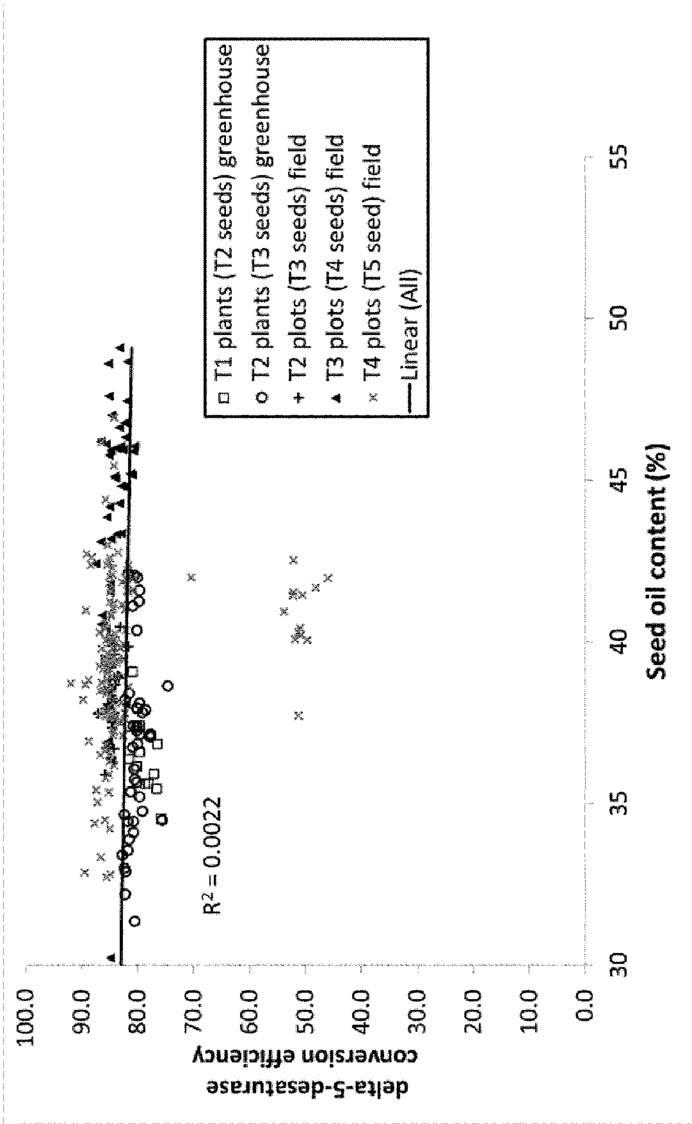

delta-5-desaturase conversion efficiency
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
30
35
40
45
50
55
Seed oil content (%)
R² = 0.0022
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 58

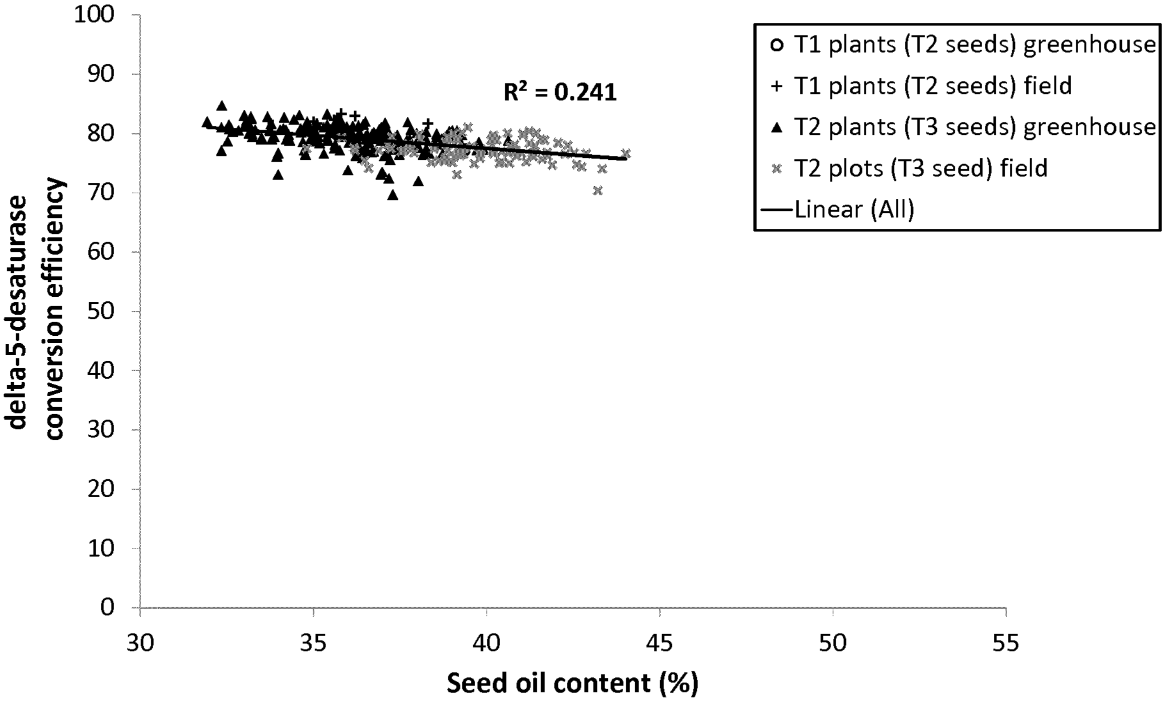

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-5-desaturase conversion efficiency
Seed oil content (%)
R² = 0.241
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 59

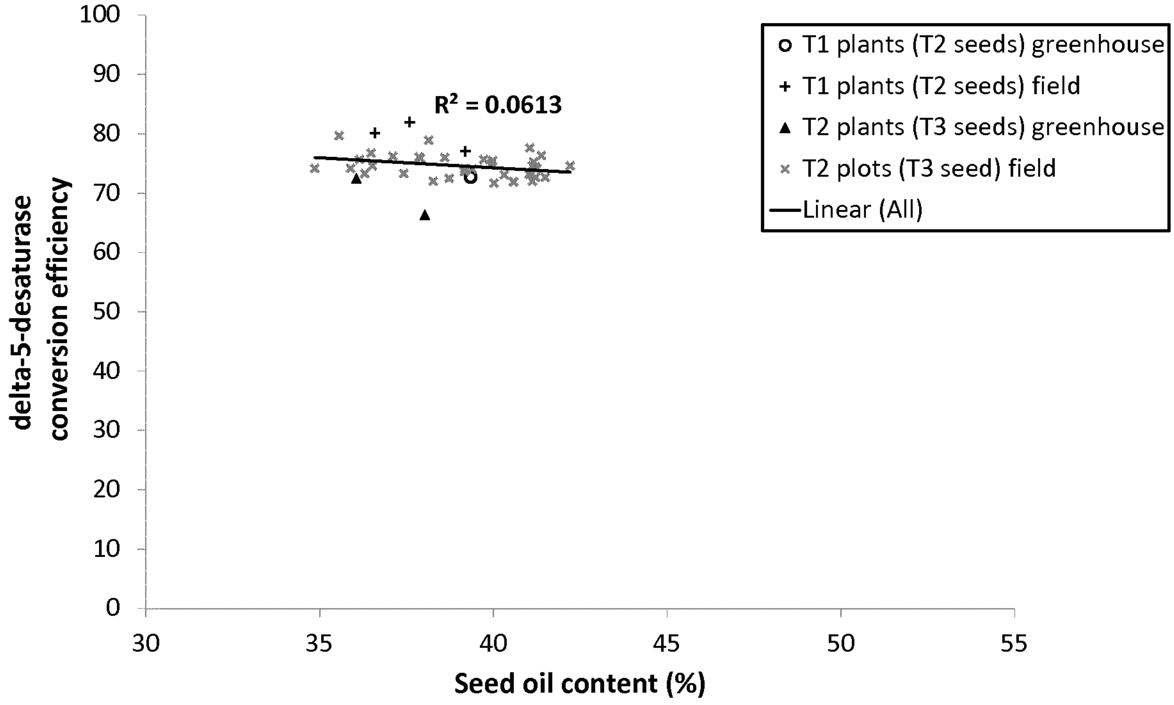

R² = 0.0613
delta-5-desaturase conversion efficiency
100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 60

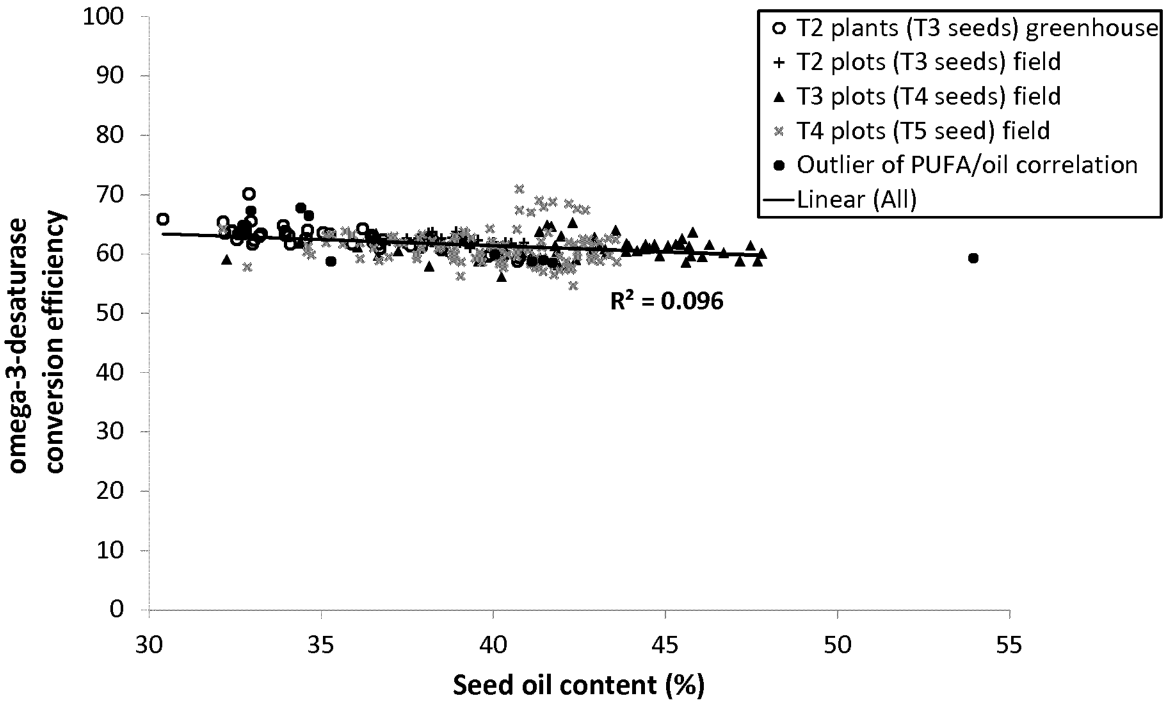

100
90
80
70
60
50
40
30
20
10
0
omega-3-desaturase conversion efficiency
30
35
40
45
50
55
Seed oil content (%)
R² = 0.096
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)

Figure 61

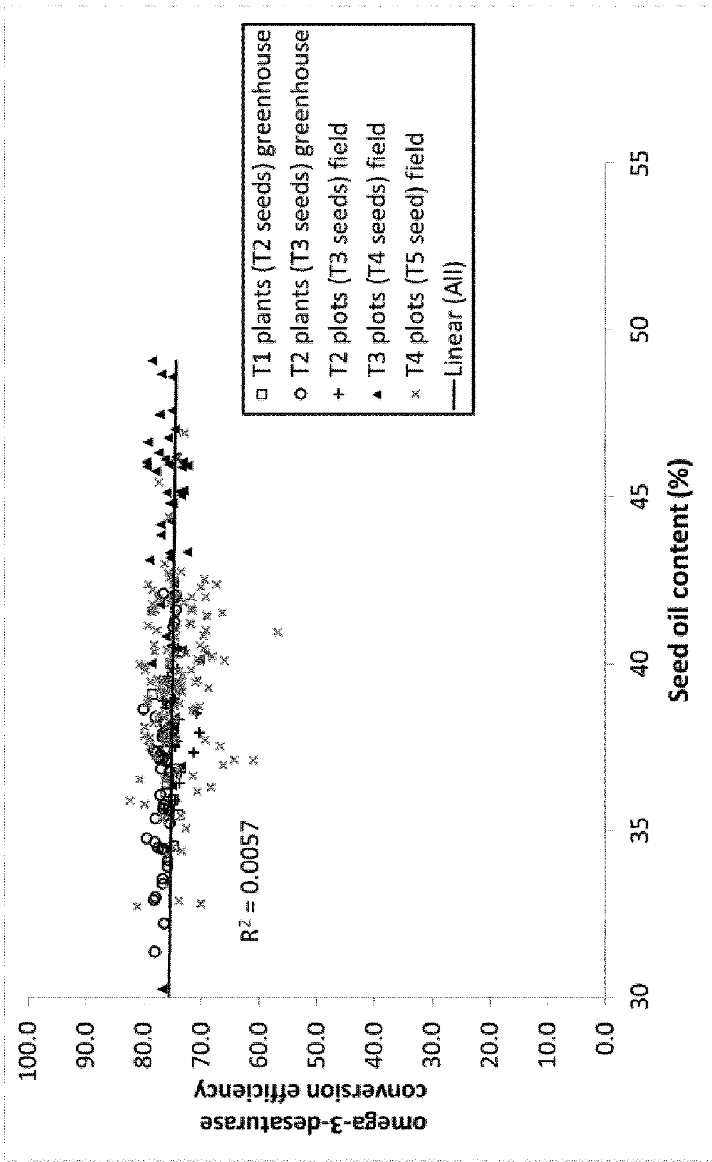

omega-3-desaturase conversion efficiency
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
30
35
40
45
50
55
Seed oil content (%)
R^2 = 0.0057
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 62

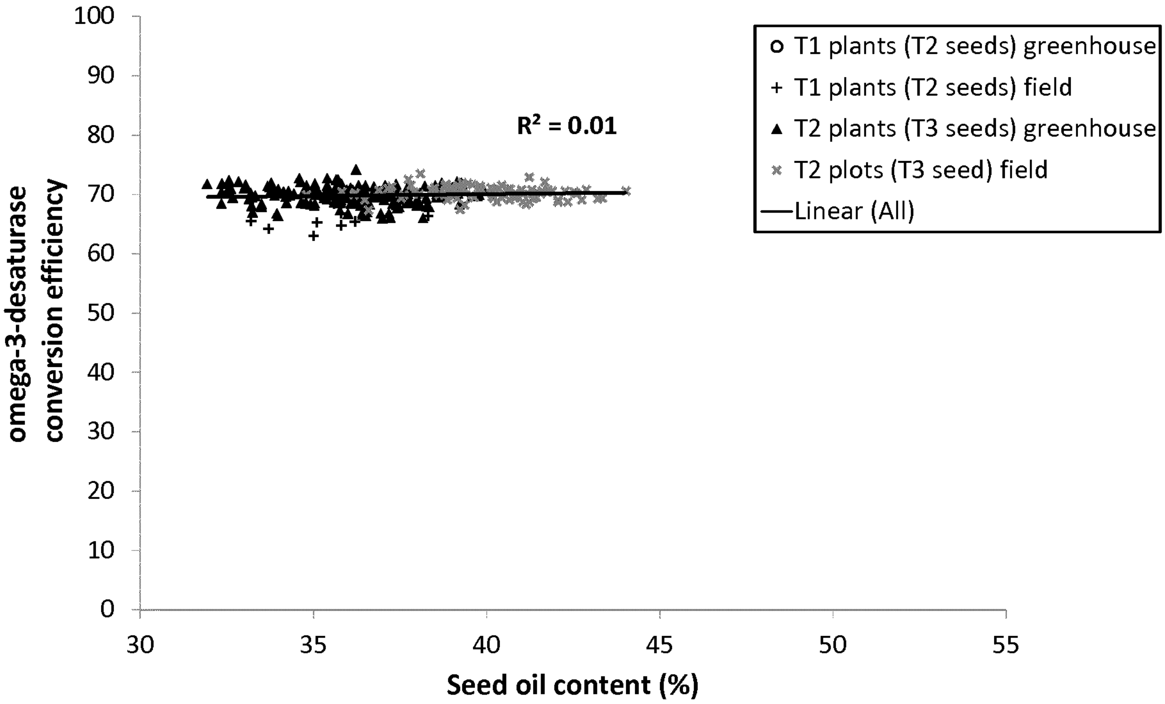

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
omega-3-desaturase conversion efficiency
Seed oil content (%)
R² = 0.01
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 63

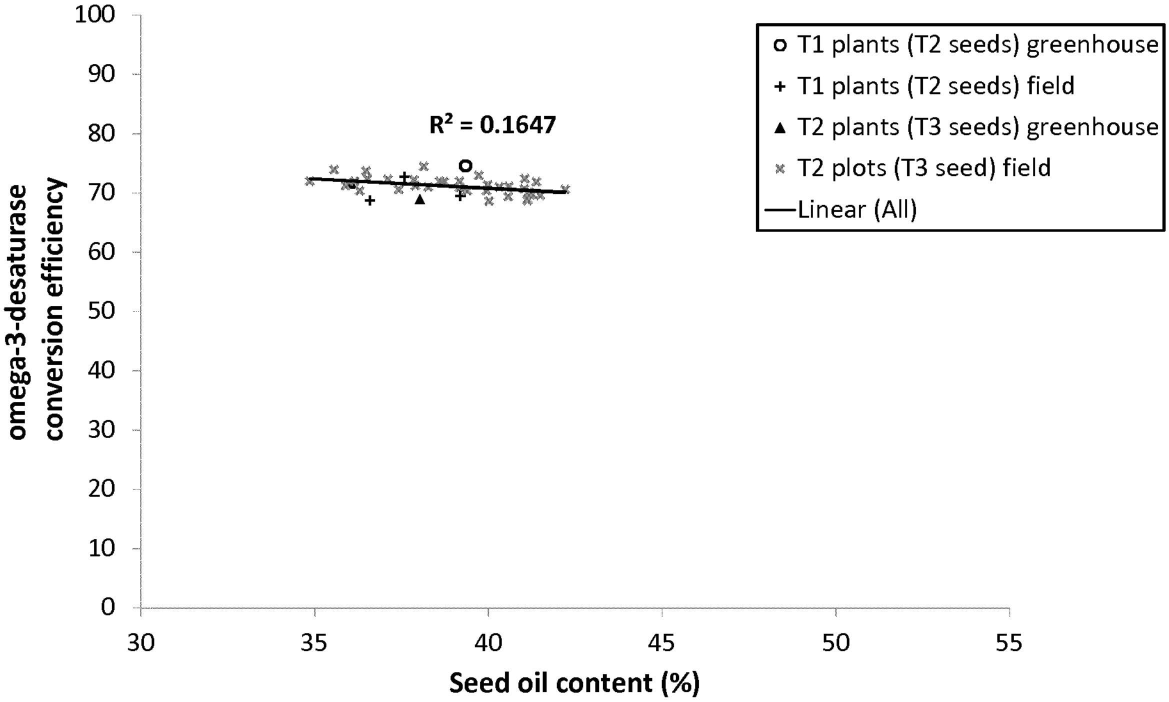

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
omega-3-desaturase conversion efficiency
Seed oil content (%)
R^2 = 0.1647
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 64

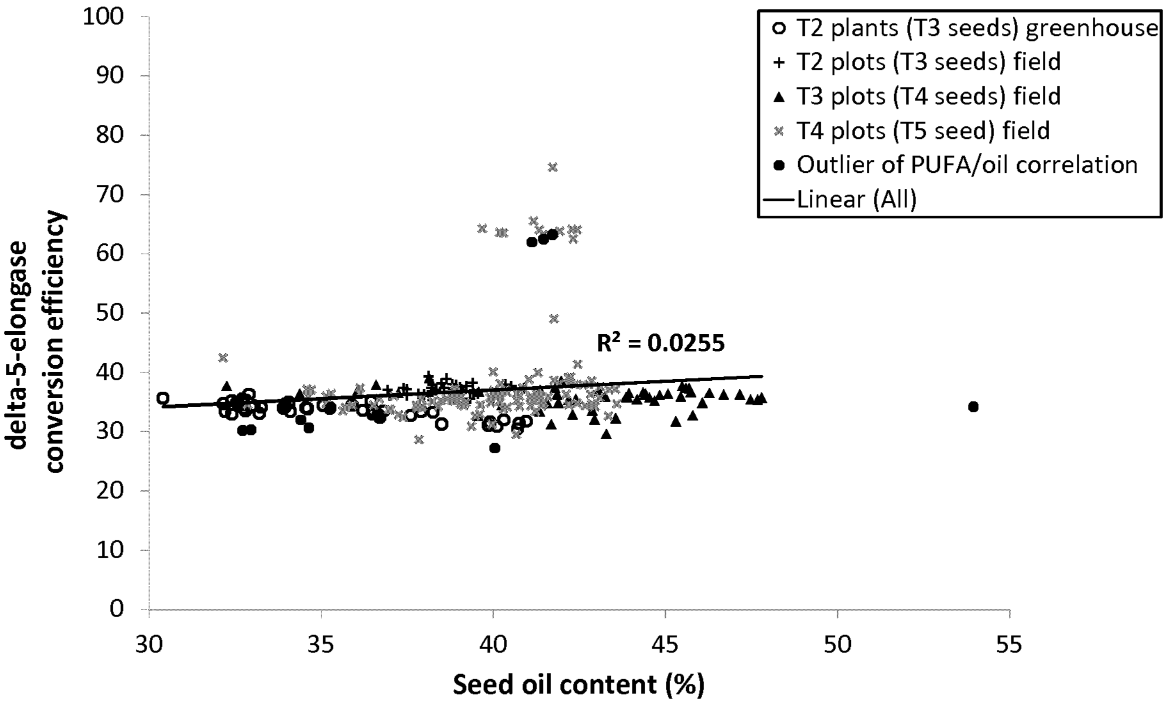

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-5-elongase conversion efficiency
Seed oil content (%)
R² = 0.0255
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)

Fig. 65

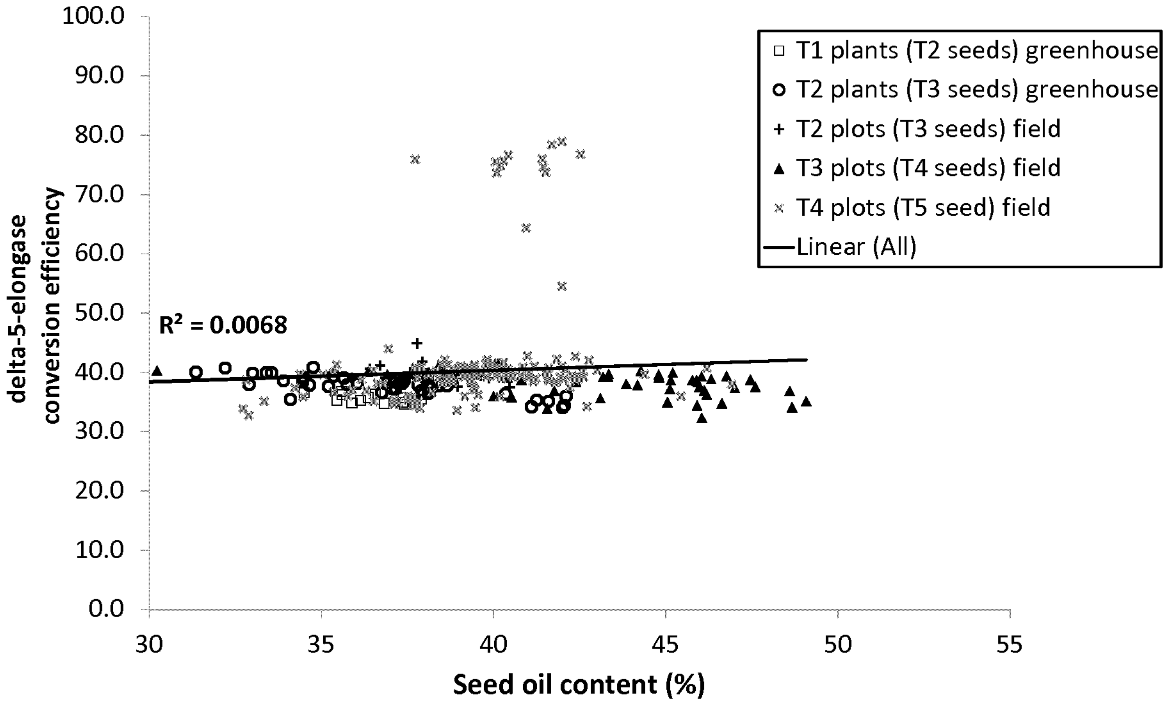

100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
delta-5-elongase conversion efficiency
R² = 0.0068
30
35
40
45
50
55
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 66

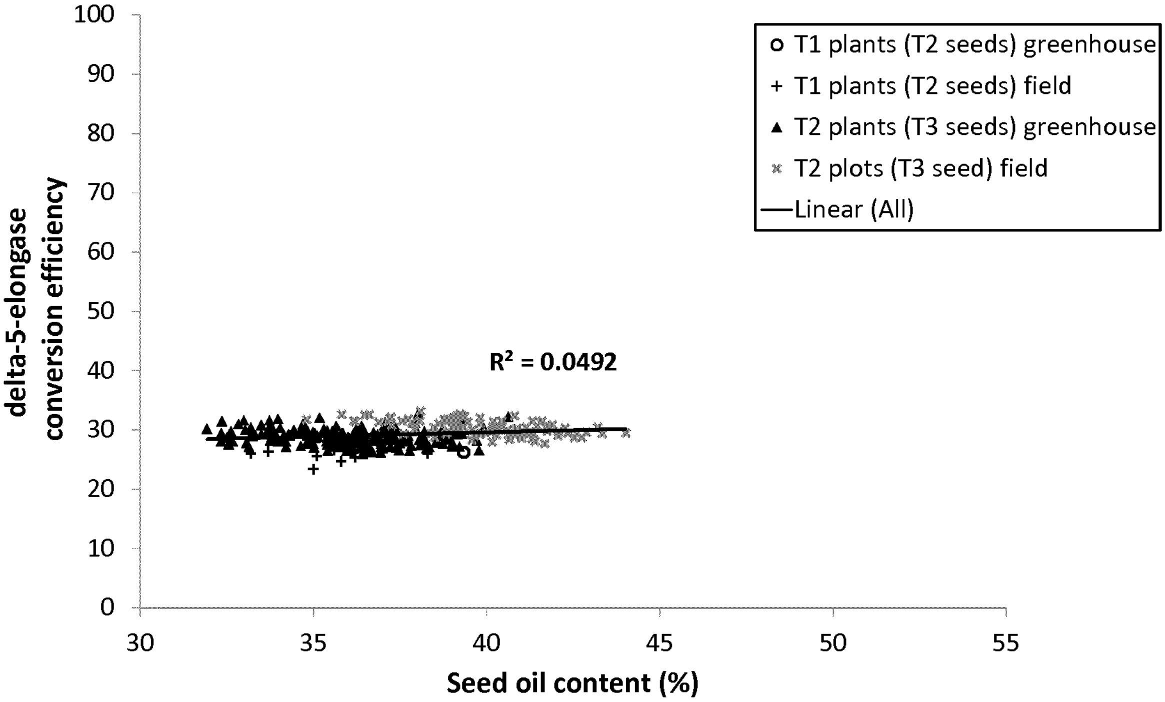

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-5-elongase conversion efficiency
Seed oil content (%)
R² = 0.0492
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 67

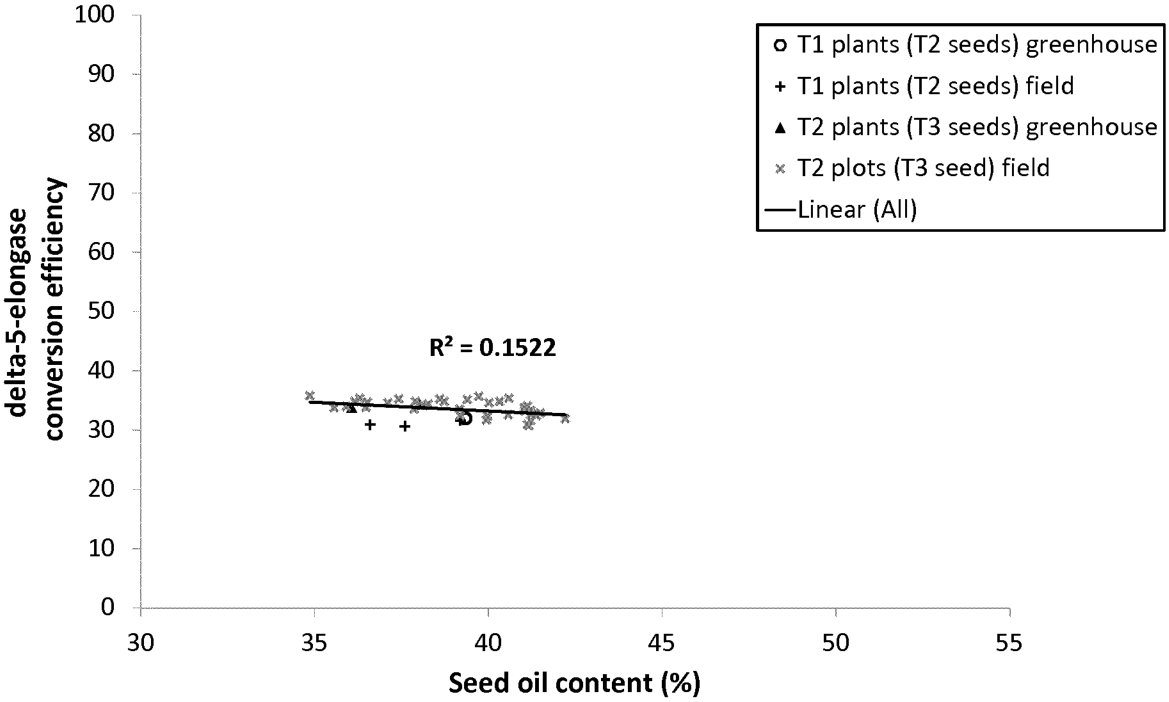

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
delta-5-elongase conversion efficiency
Seed oil content (%)
R² = 0.1522
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 68

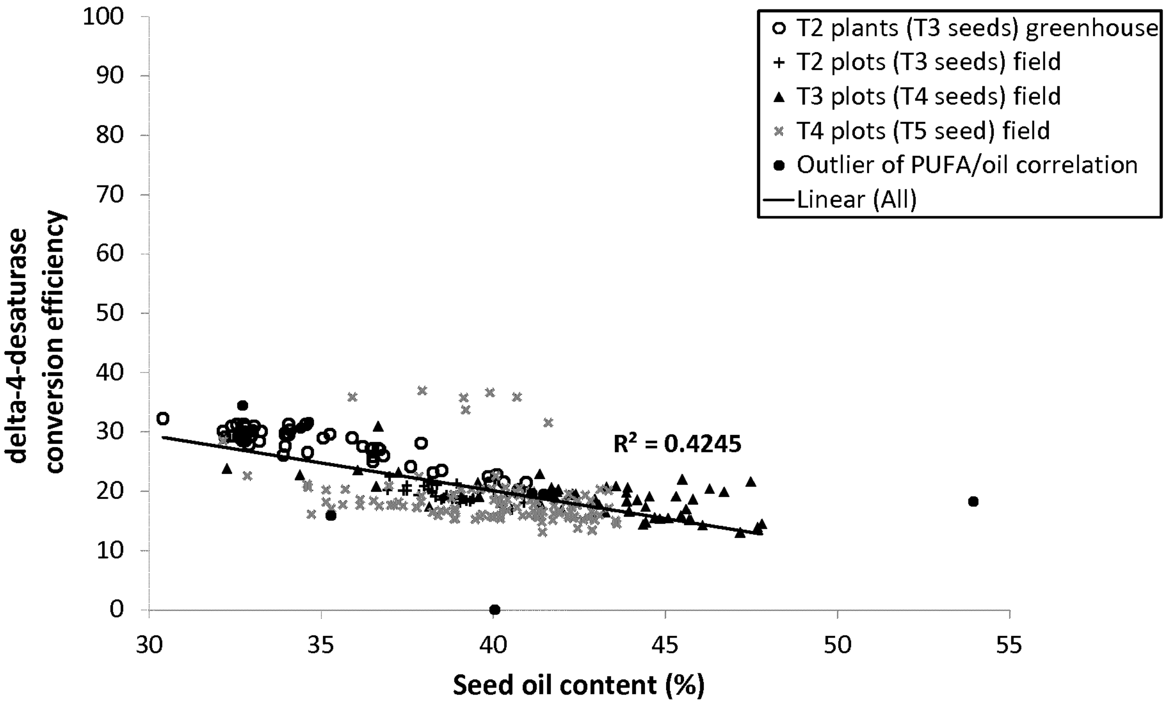

T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)
R² = 0.4245
delta-4-desaturase conversion efficiency
Seed oil content (%)
100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55

Fig. 69

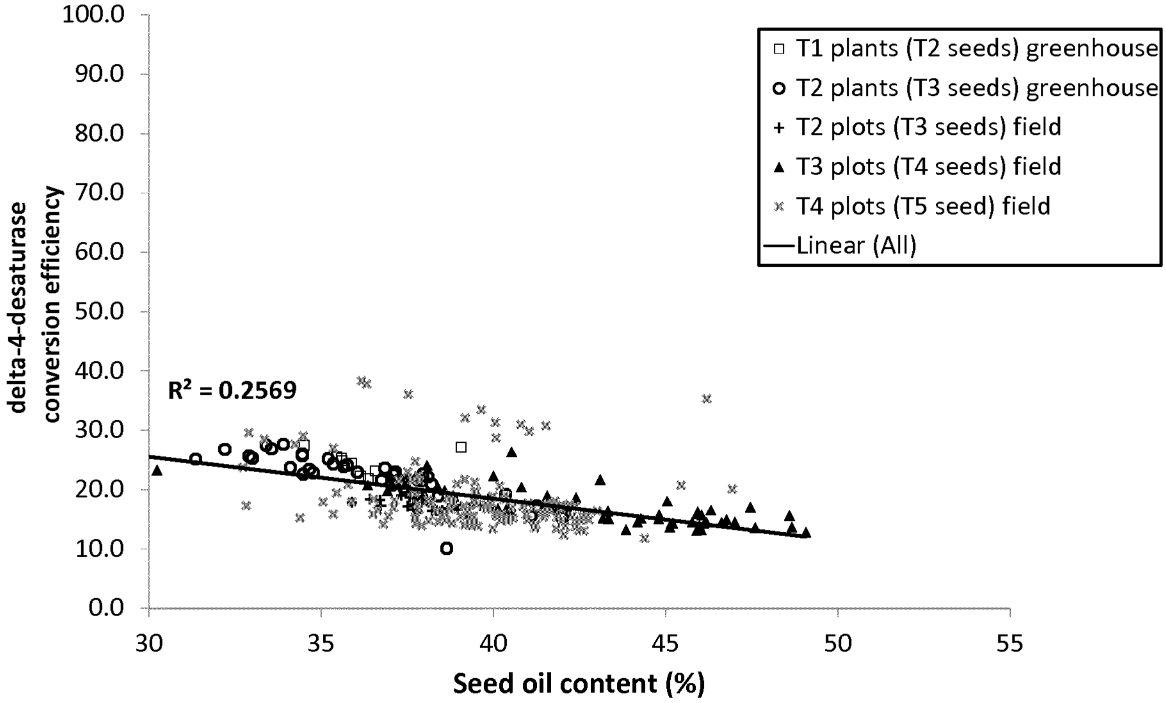

100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
30
35
40
45
50
55
delta-4-desaturase conversion efficiency
Seed oil content (%)
R² = 0.2569
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)

Fig. 70

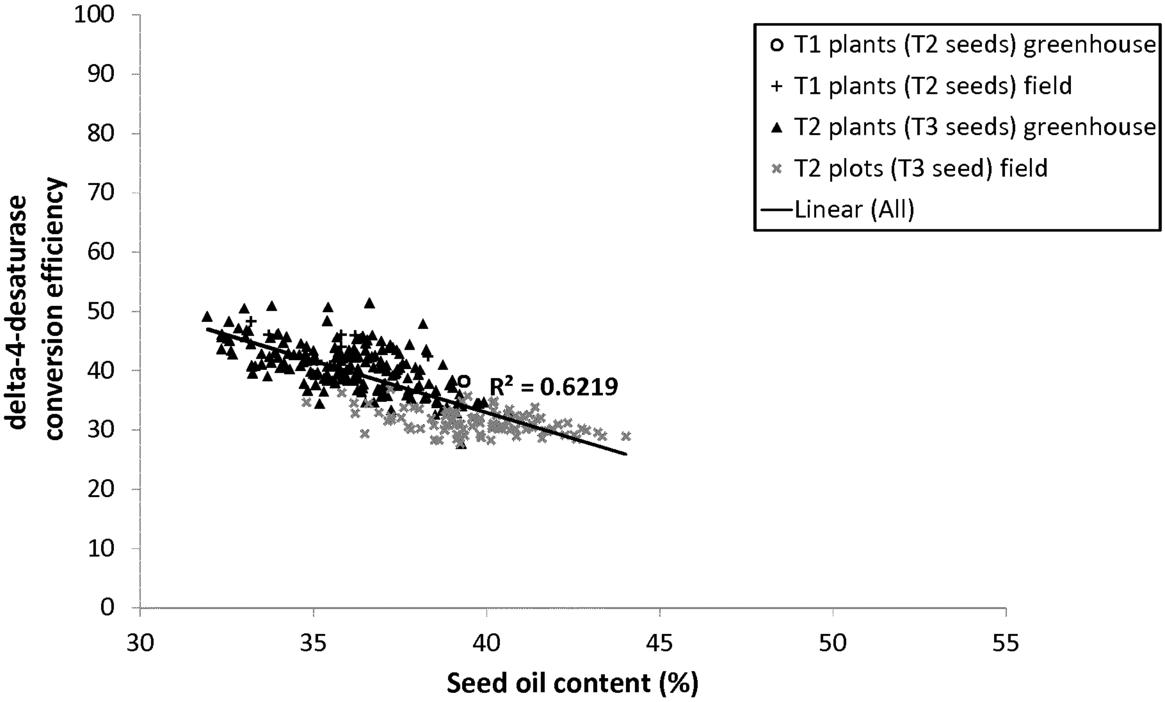

100
90
80
70
60
50
40
30
20
10
0
delta-4-desaturase conversion efficiency
30
35
40
45
50
55
Seed oil content (%)
R^2 = 0.6219
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 71

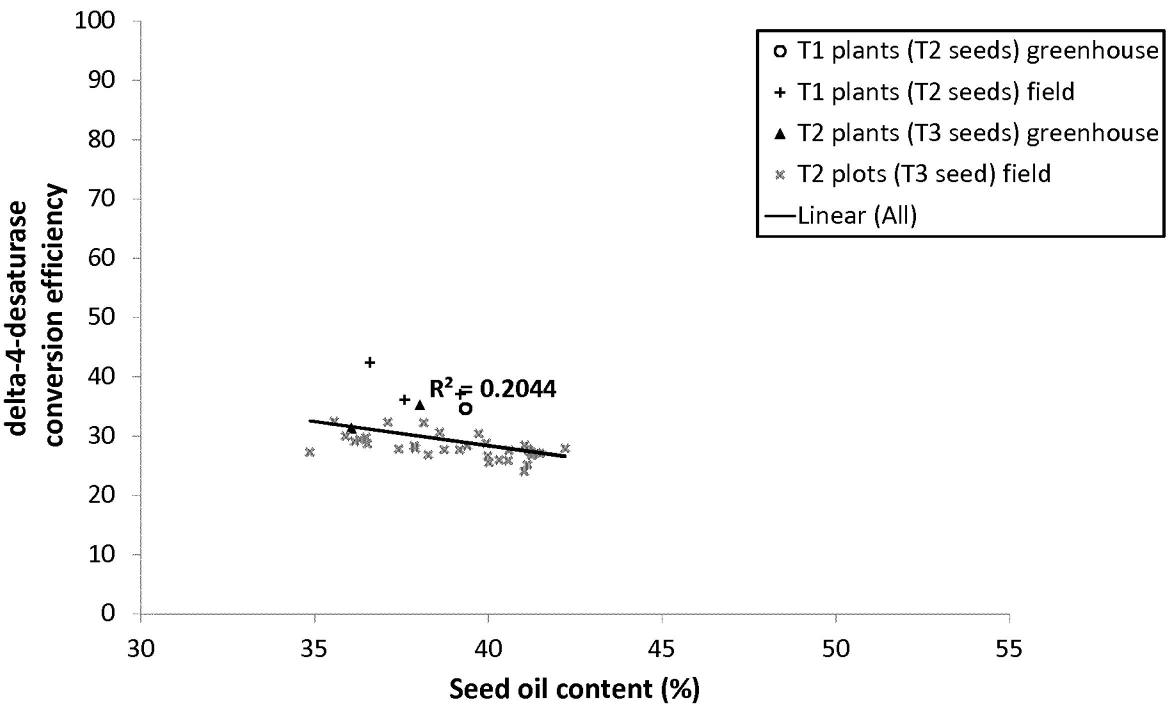

100
90
80
70
60
50
40
30
20
10
0
30
35
40
45
50
55
Seed oil content (%)
delta-4-desaturase conversion efficiency
R^2 = 0.2044
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 72

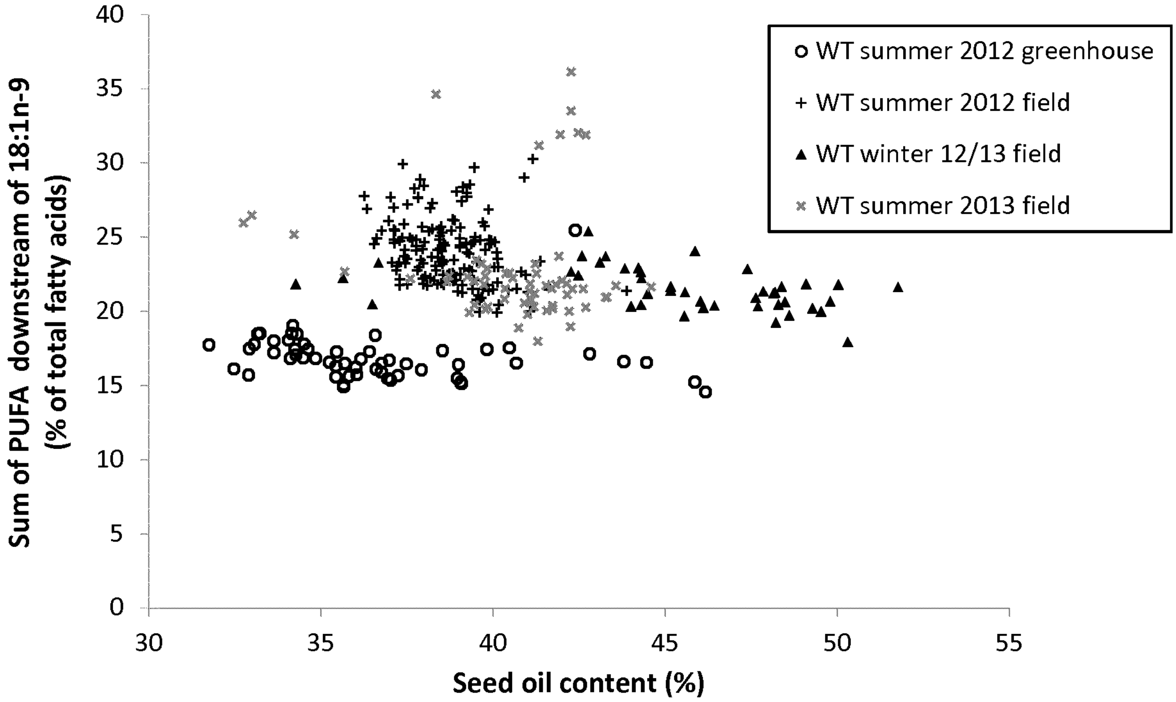

Sum of PUFA downstream of 18:1n-9
(% of total fatty acids)
Seed oil content (%)
WT summer 2012 greenhouse
WT summer 2012 field
WT winter 12/13 field
WT summer 2013 field
40
35
30
25
20
15
10
5
0
30
35
40
45
50
55

Fig. 73

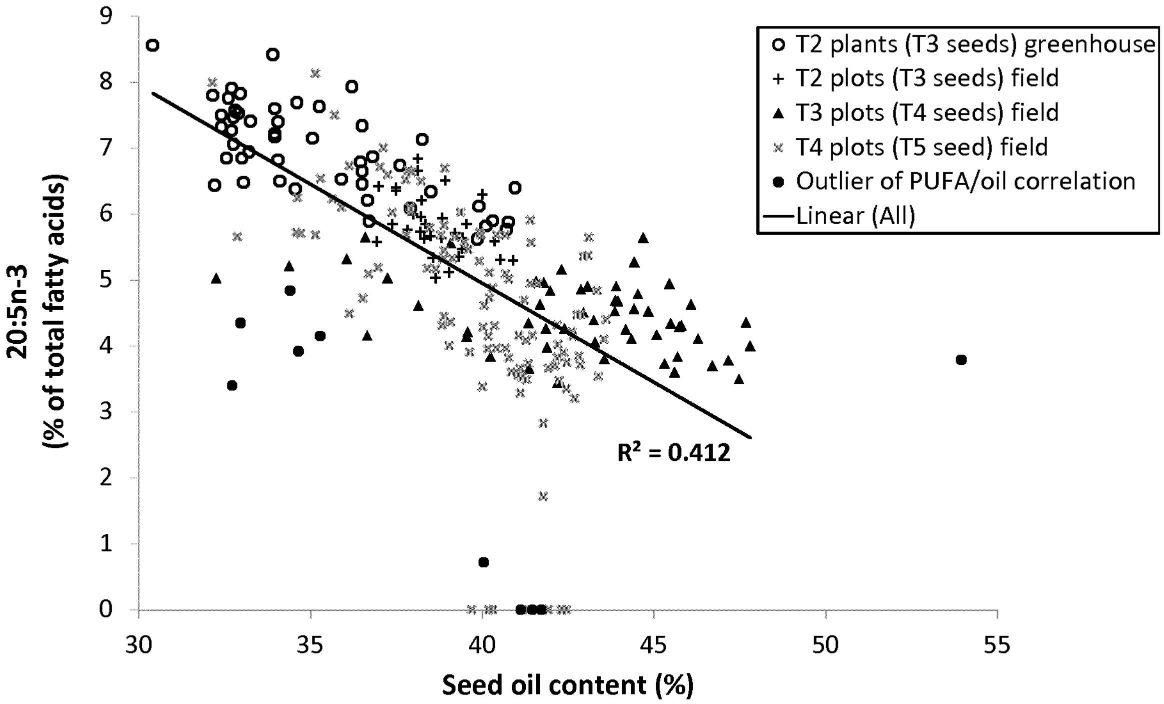

T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)
20:5n-3
(% of total fatty acids)
Seed oil content (%)
R² = 0.412
0
1
2
3
4
5
6
7
8
9
30
35
40
45
50
55

Fig. 74

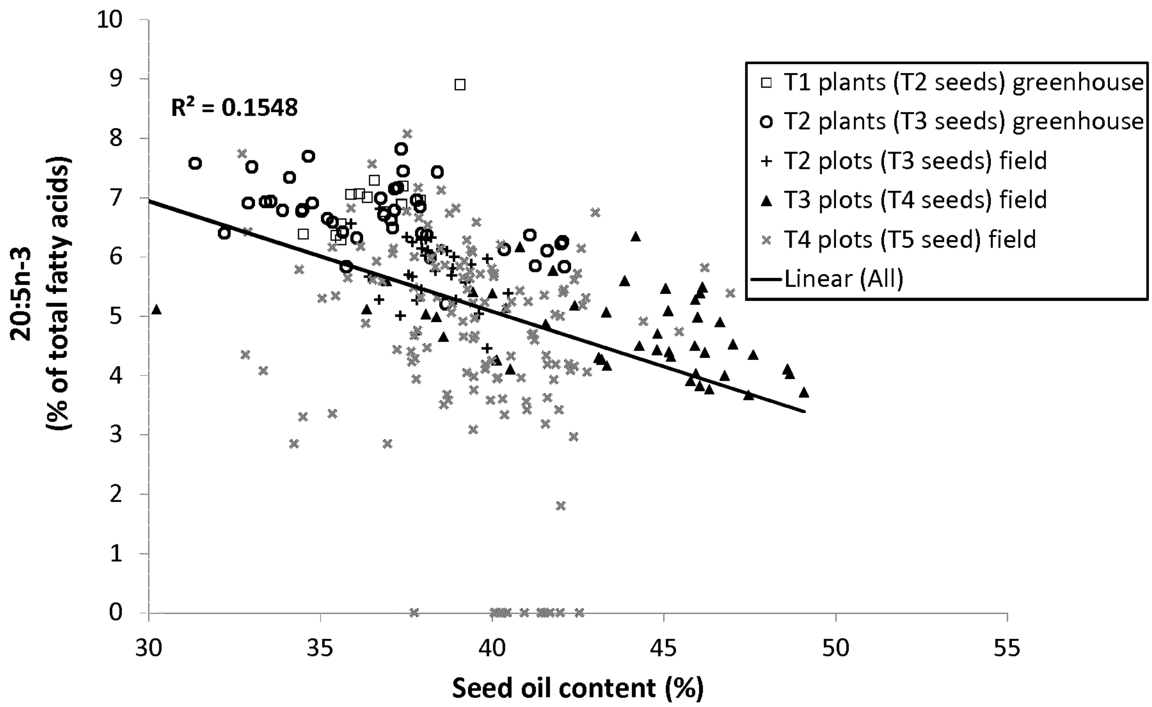

R² = 0.1548
20:5n-3
(% of total fatty acids)
Seed oil content (%)
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)
0
1
2
3
4
5
6
7
8
9
10
30
35
40
45
50
55

Fig. 75

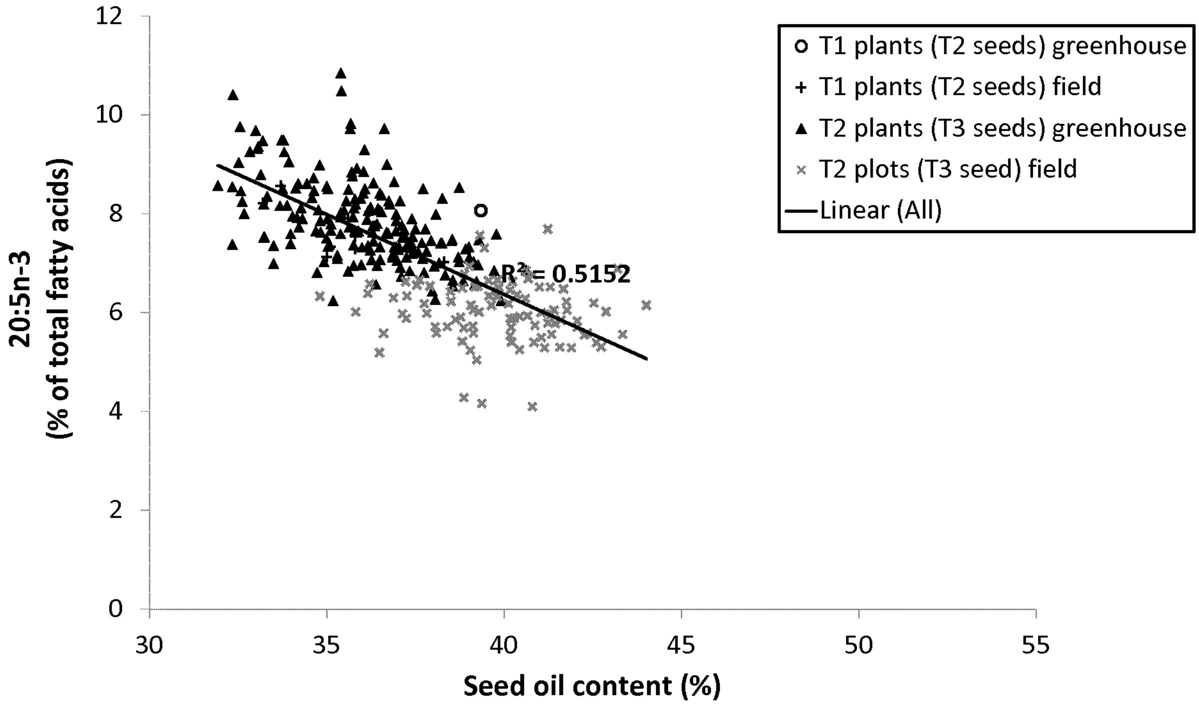

12
10
8
6
4
2
0
20:5n-3
(% of total fatty acids)
30
35
40
45
50
55
Seed oil content (%)
$R^2 = 0.5152$
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 76

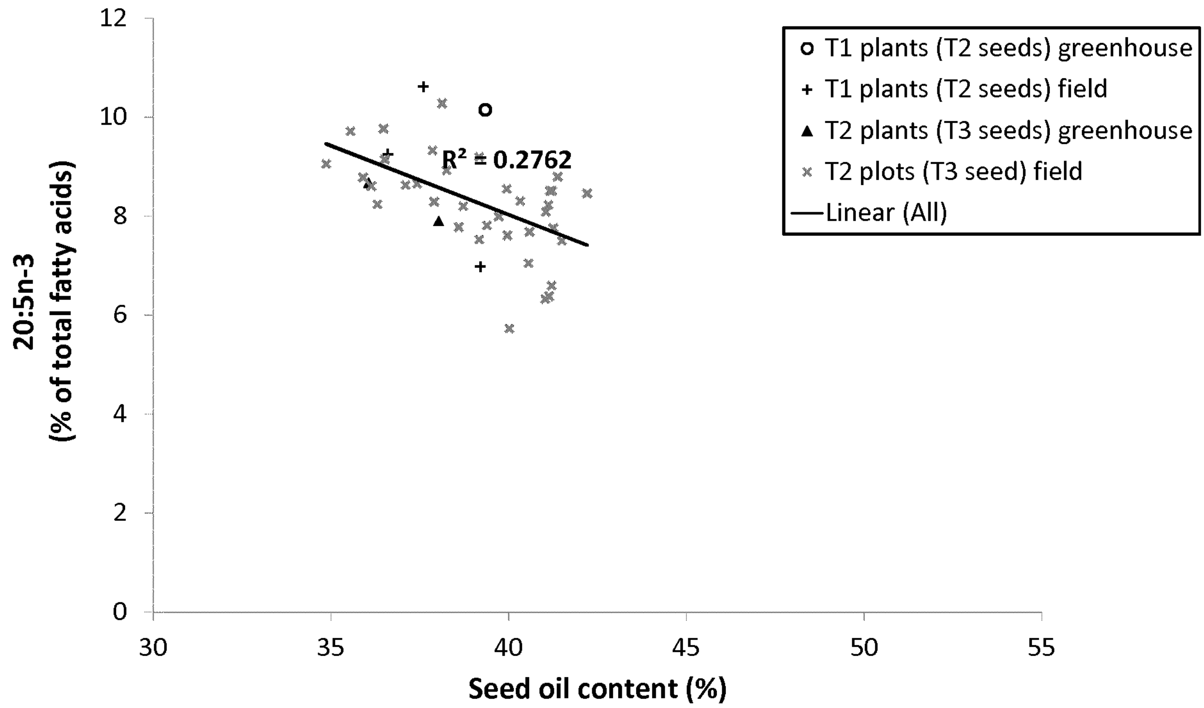

12
10
8
6
4
2
0
30
35
40
45
50
55
20:5n-3
(% of total fatty acids)
Seed oil content (%)
R² = 0.2762
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 77

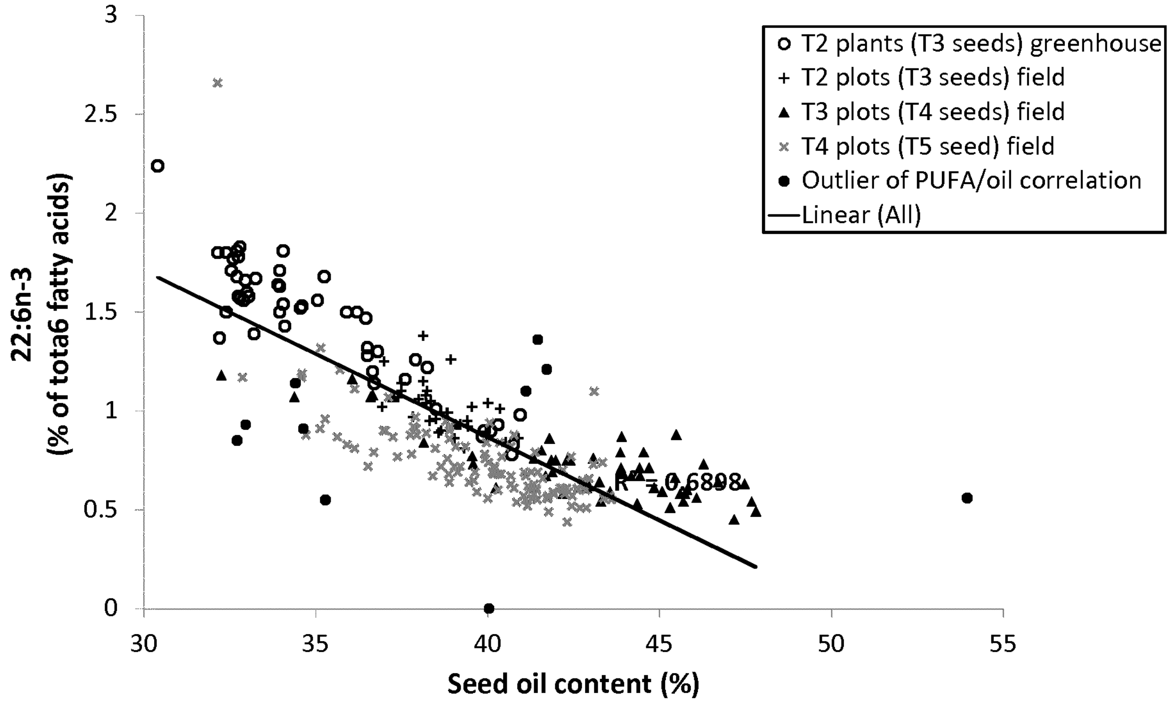

3
2.5
2
1.5
1
0.5
0
30
35
40
45
50
55
22:6n-3
(% of tota6 fatty acids)
Seed oil content (%)
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Outlier of PUFA/oil correlation
Linear (All)
R = 0.6898

Fig. 78

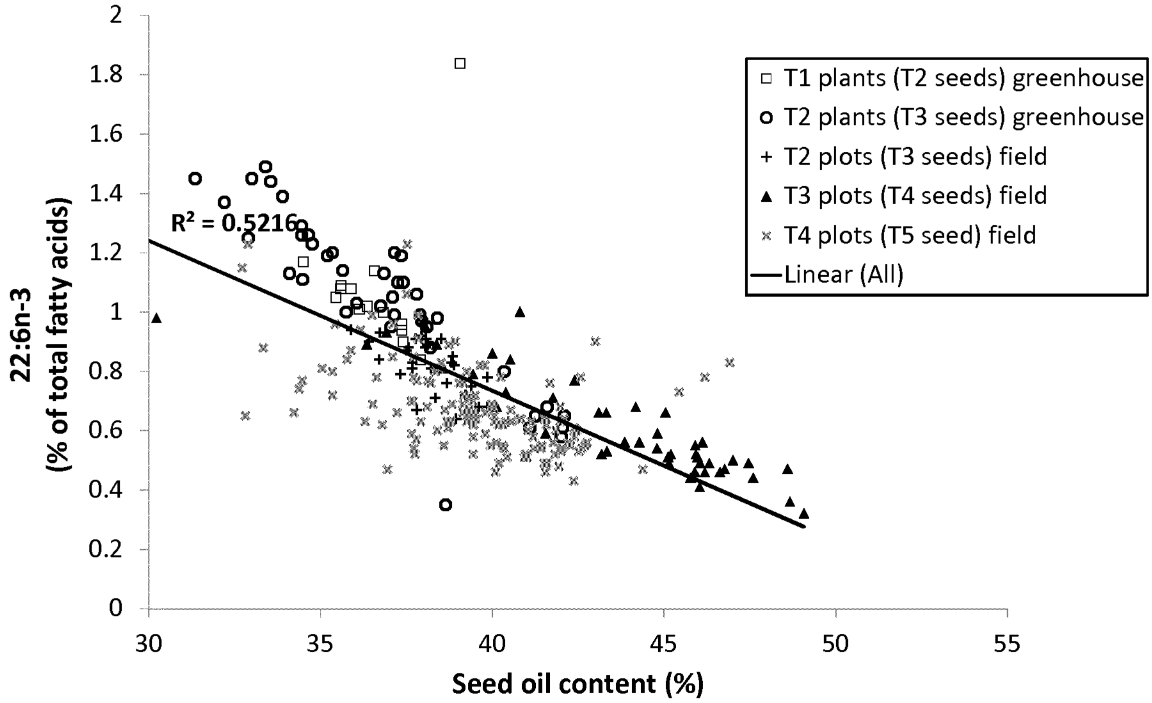

22:6n-3
(% of total fatty acids)
Seed oil content (%)
R² = 0.5216
T1 plants (T2 seeds) greenhouse
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seeds) field
T3 plots (T4 seeds) field
T4 plots (T5 seed) field
Linear (All)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
30
35
40
45
50
55

Fig. 79

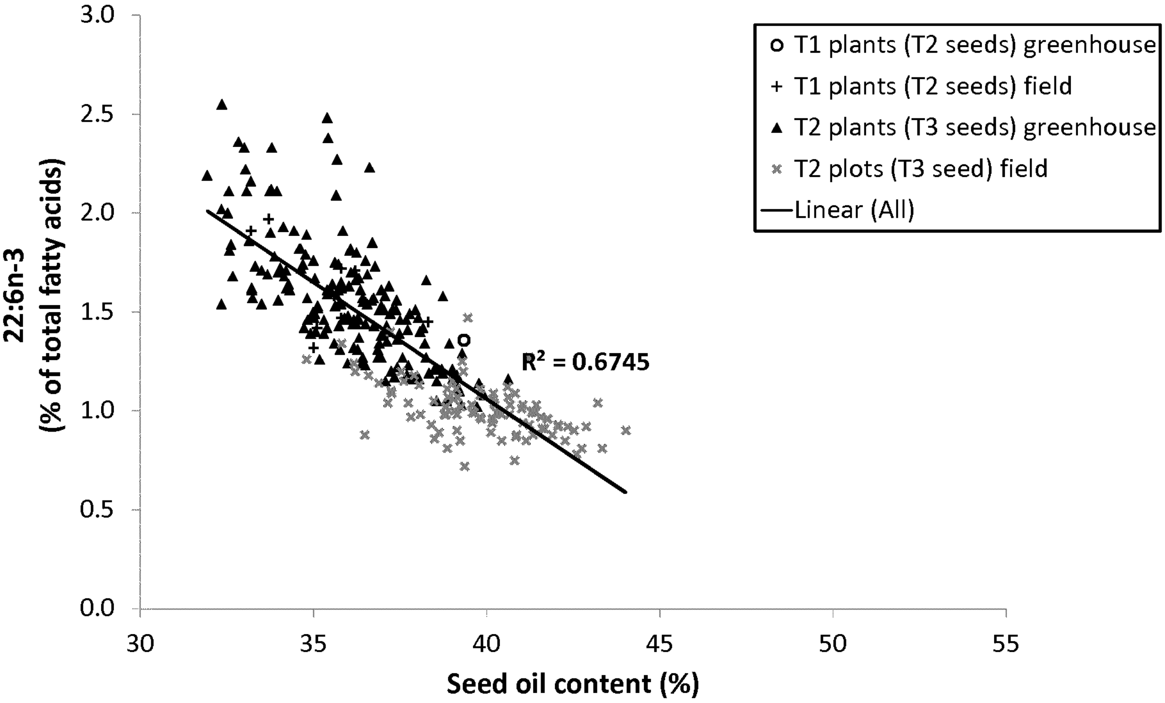
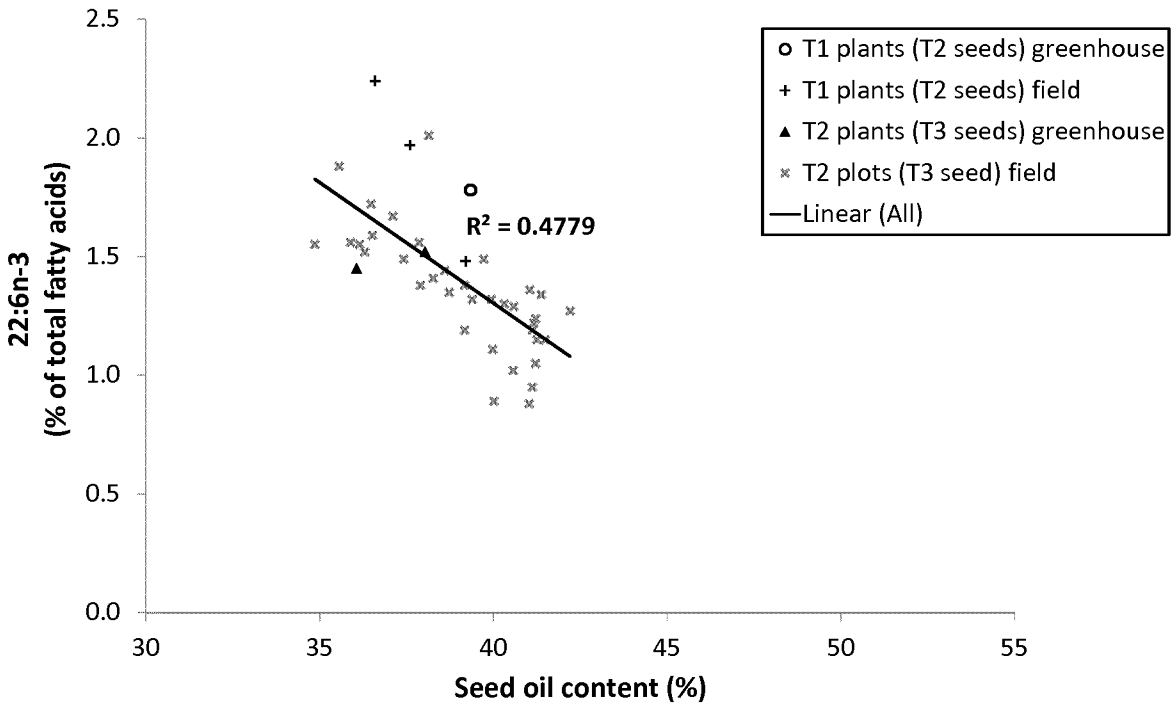

3.0
2.5
2.0
1.5
1.0
0.5
0.0
22:6n-3
(% of total fatty acids)
30
35
40
45
50
55
Seed oil content (%)
R² = 0.6745
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

Fig. 80


2.5
2.0
1.5
1.0
0.5
0.0
22:6n-3
(% of total fatty acids)
30
35
40
45
50
55
Seed oil content (%)
R² = 0.4779
T1 plants (T2 seeds) greenhouse
T1 plants (T2 seeds) field
T2 plants (T3 seeds) greenhouse
T2 plots (T3 seed) field
Linear (All)

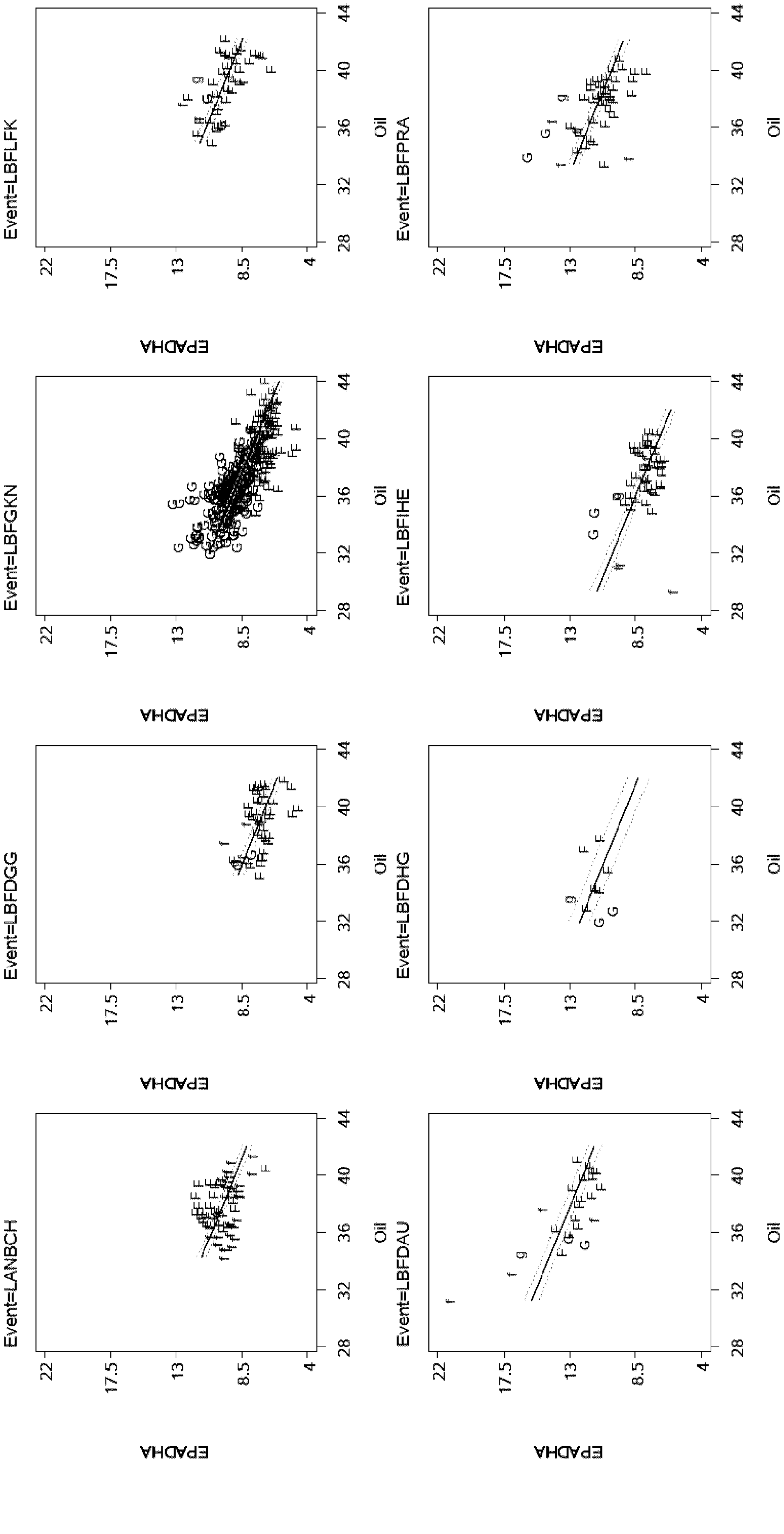

Event=LANBCH
Event=LBFDGG
Event=LBFGKN
Event=LBFLFK
Event=LBFDAU
Event=LBFDHG
Event=LBFIHE
Event=LBFPRA
EPADHA
Oil

Fig. 81

Fig. 82

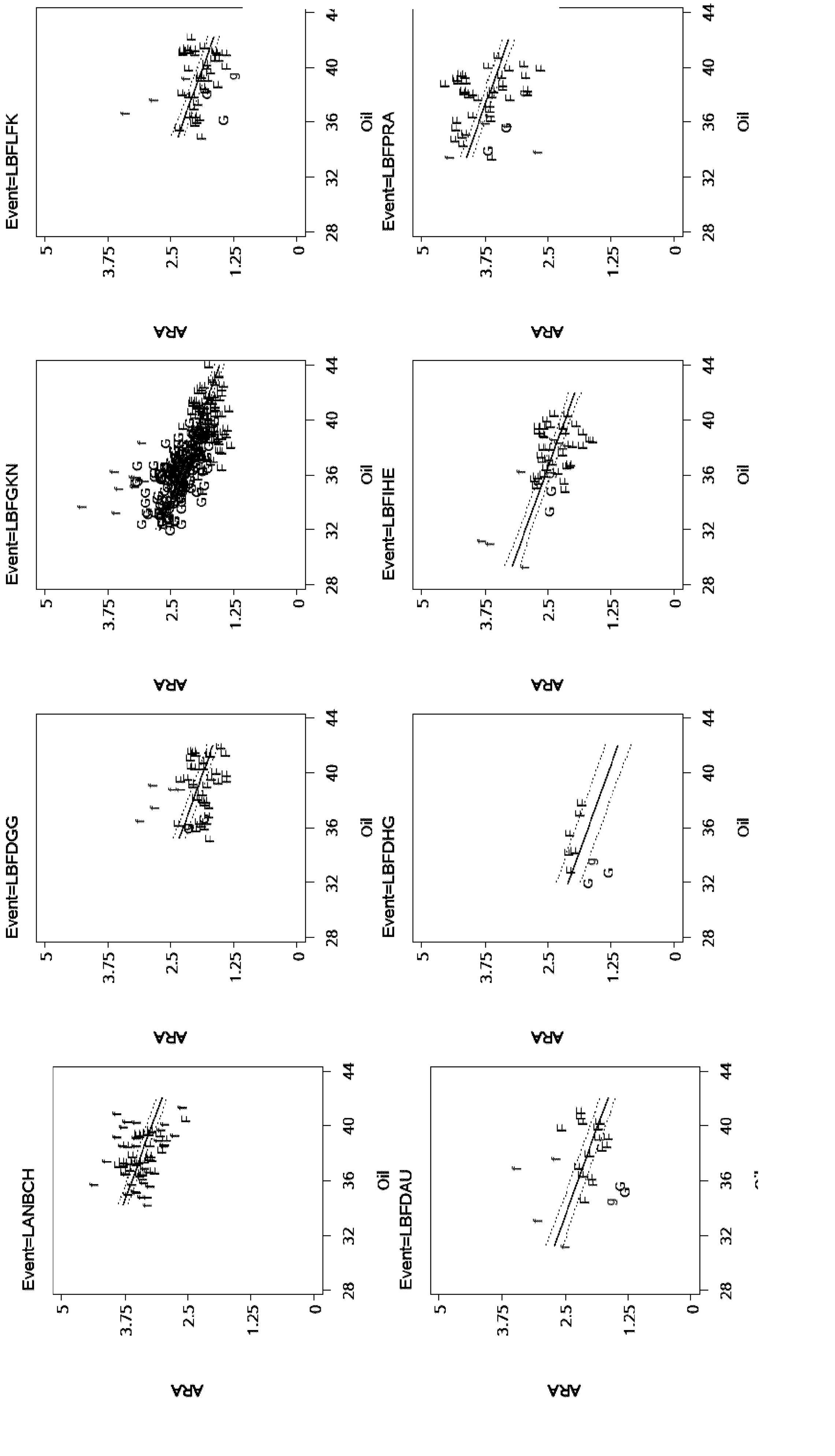

Event=LANBCH
Event=LBFDGG
Event=LBFGKN
Event=LBFLFK
Event=LBFDAU
Event=LBFDHG
Event=LBFIHE
Event=LBFPRA
ARA
Oil
5
3.75
2.5
1.25
0
28
32
36
40
44

Fig. 83

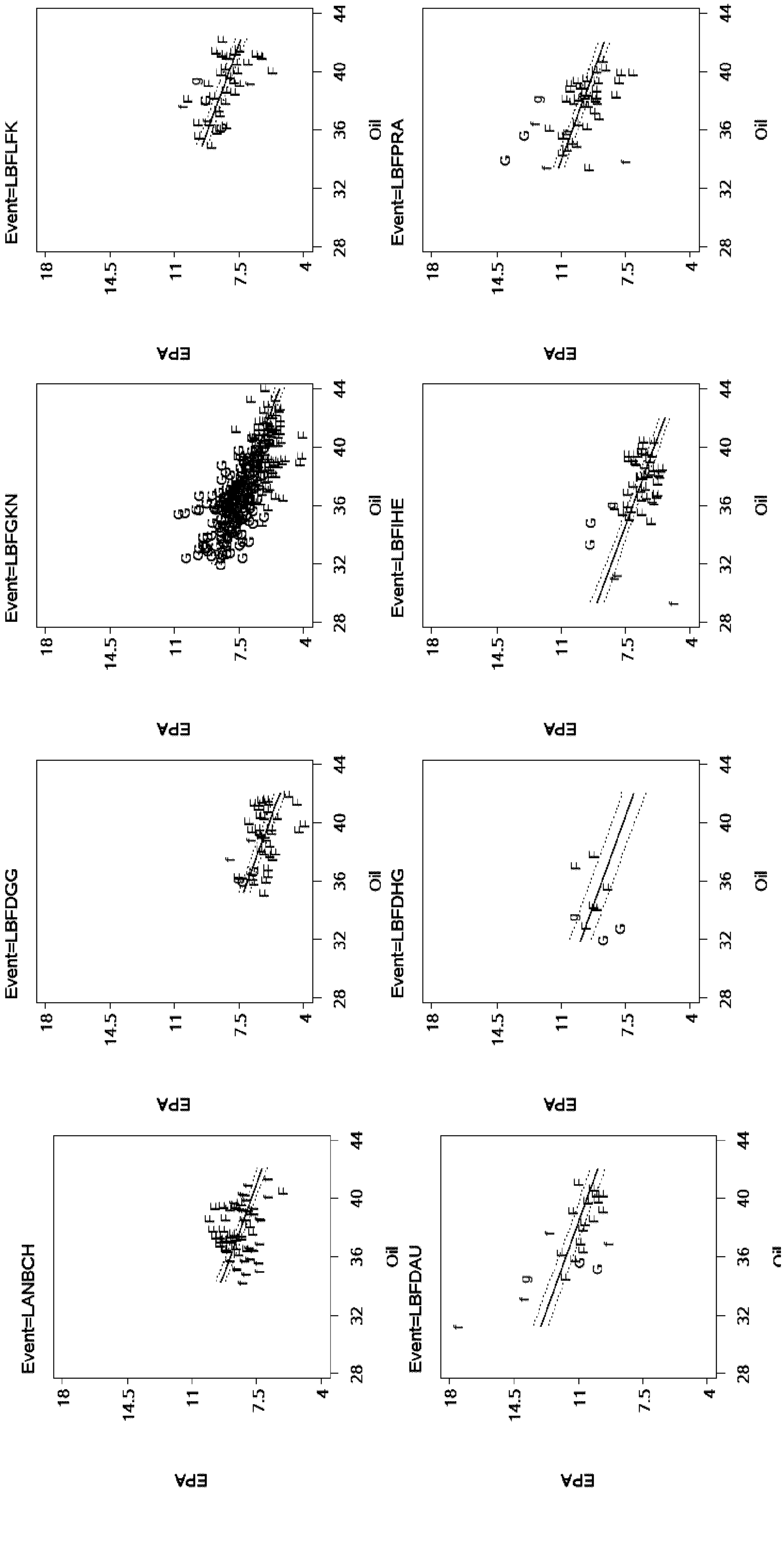

Event=LANBCH
Event=LBFDGG
Event=LBFGKN
Event=LBFLFK
Event=LBFDAU
Event=LBFDHG
Event=LBFIHE
Event=LBFPRA
EPA
Oil
18
14.5
11
7.5
4
28
32
36
40
44

Fig. 84

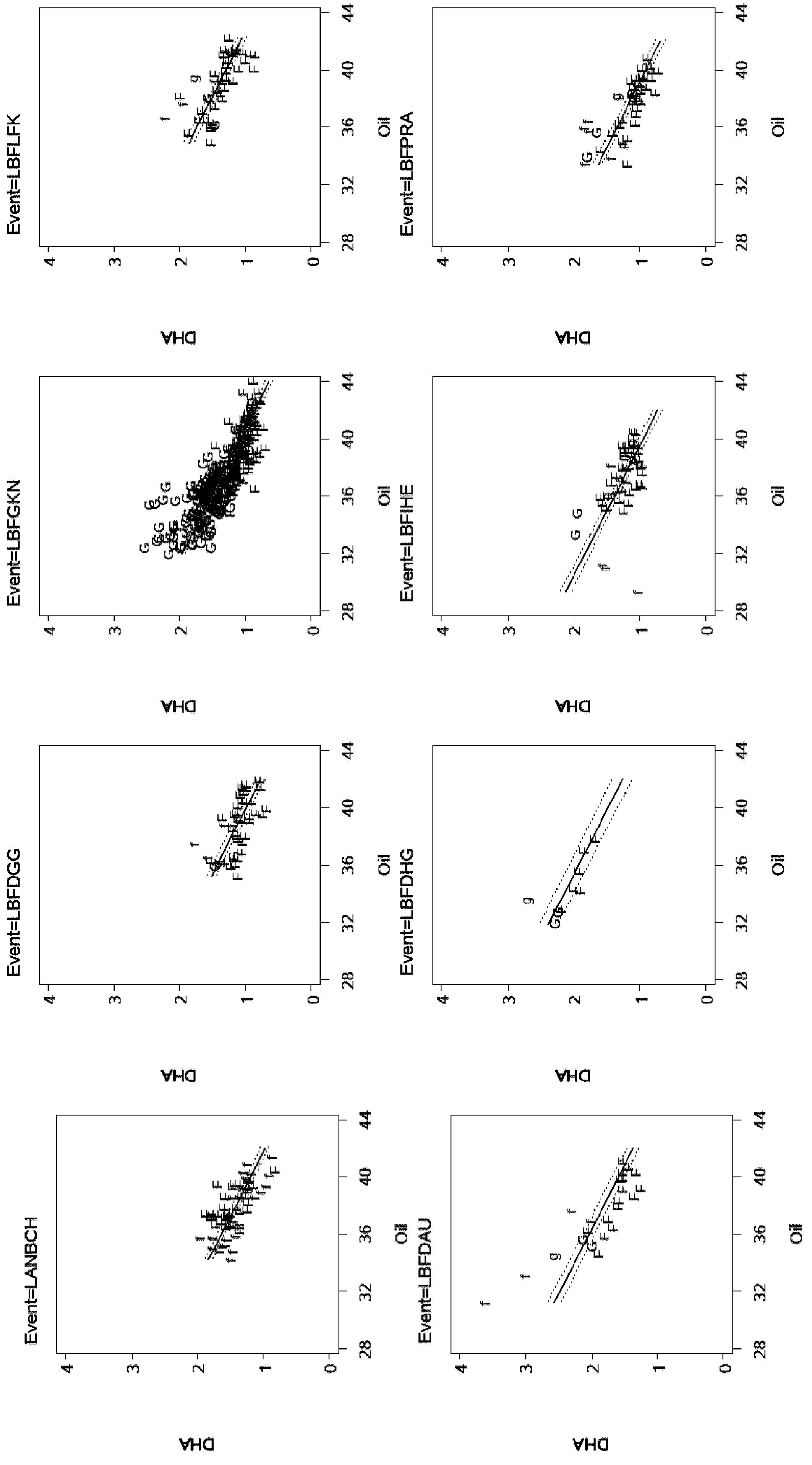

Event=LANBCH
Event=LBFDGG
Event=LBFGKN
Event=LBFLFK
Event=LBFDAU
Event=LBFDHG
Event=LBFIHE
Event=LBFPRA
DHA
Oil

Fig. 85

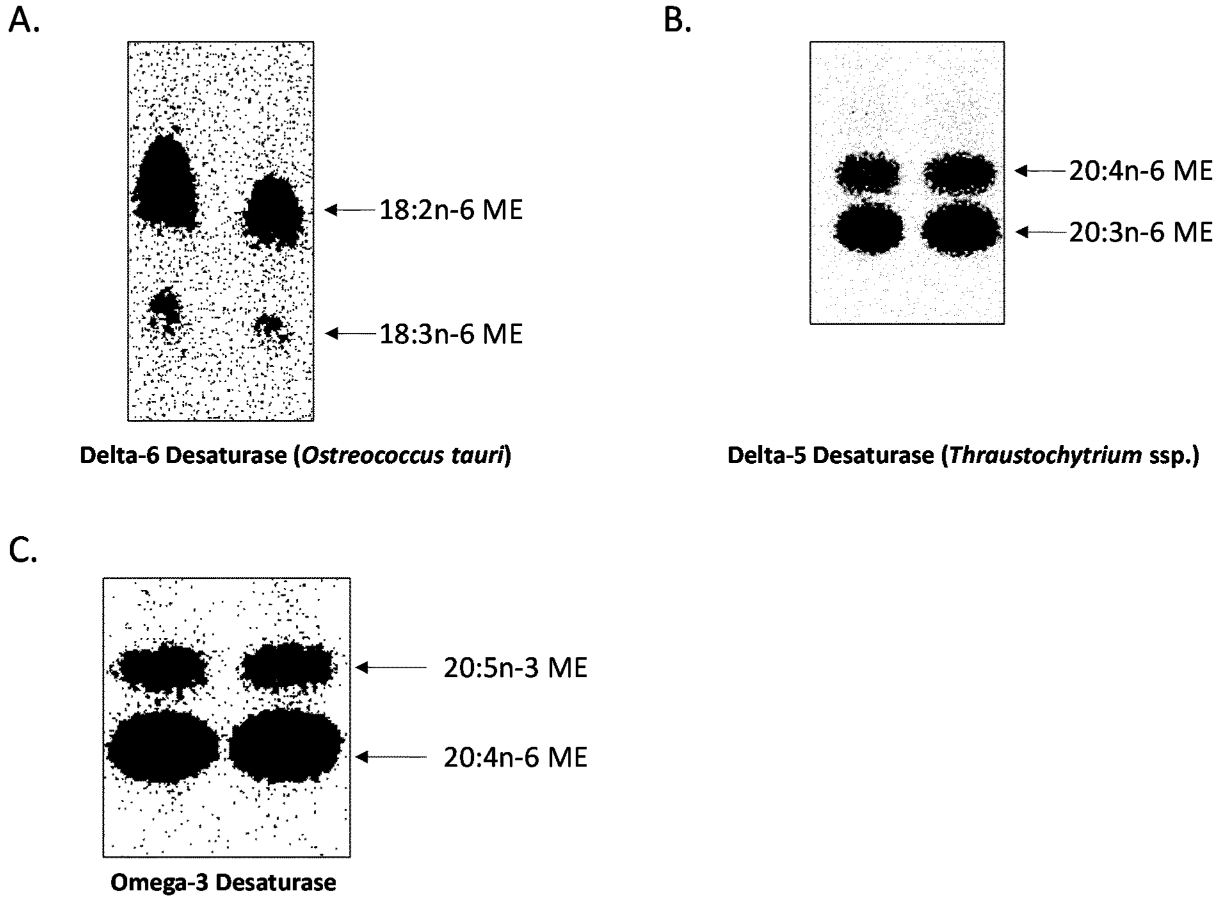
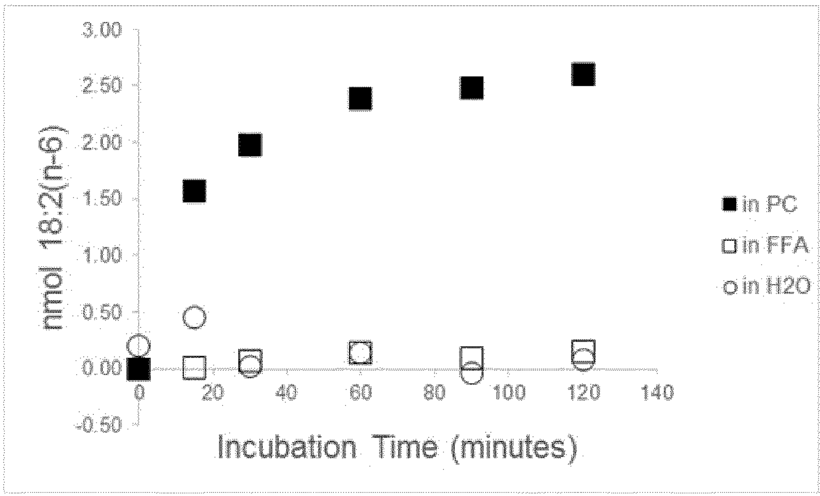

A.
18:2n-6 ME
18:3n-6 ME
Delta-6 Desaturase (*Ostreococcus tauri*)
B.
20:4n-6 ME
20:3n-6 ME
Delta-5 Desaturase (*Thraustochytrium* ssp.)
C.
20:5n-3 ME
20:4n-6 ME
Omega-3 Desaturase

Fig. 86

A.


3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
nmol 18:2(n-6)
0
20
40
60
80
100
120
140
Incubation Time (minutes)
in PC
in FFA
in H2O

B.

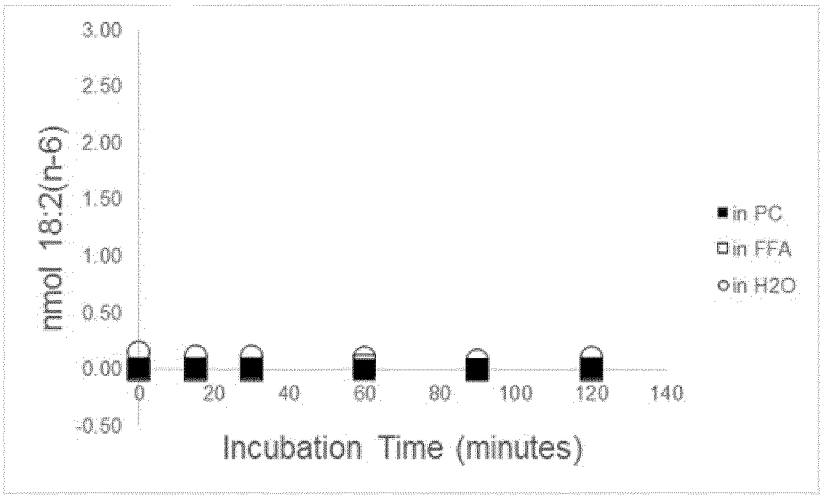
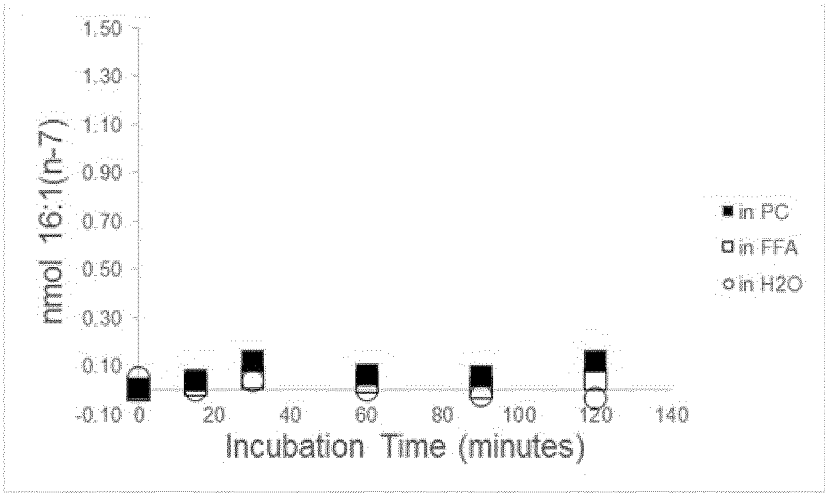

3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
nmol 18:2(n-6)
0
20
40
60
80
100
120
140
Incubation Time (minutes)
in PC
in FFA
in H2O

Fig. 87

A.


1.50
1.30
1.10
0.90
0.70
0.50
0.30
0.10
-0.10
nmol 16:1(n-7)
0
20
40
60
80
100
120
140
Incubation Time (minutes)
in PC
in FFA
in H2O

B.

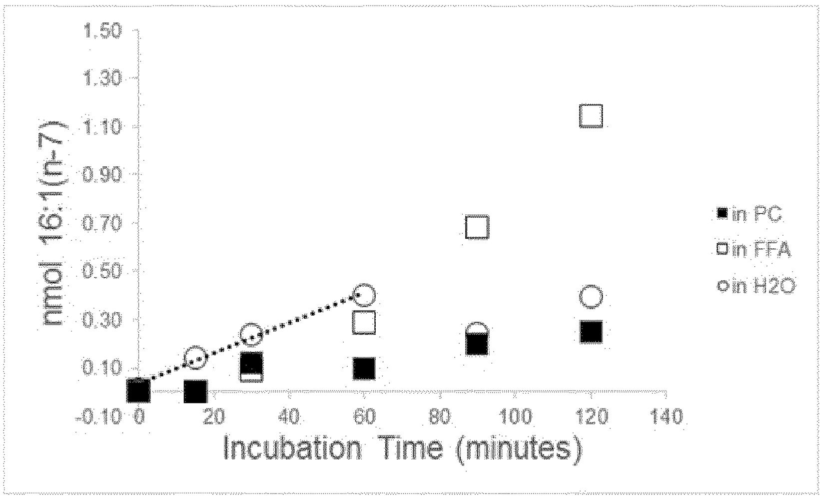

1.50
1.30
1.10
0.90
0.70
0.50
0.30
0.10
-0.10
nmol 16:1(n-7)
0
20
40
60
80
100
120
140
Incubation Time (minutes)
in PC
in FFA
in H2O

Fig. 88

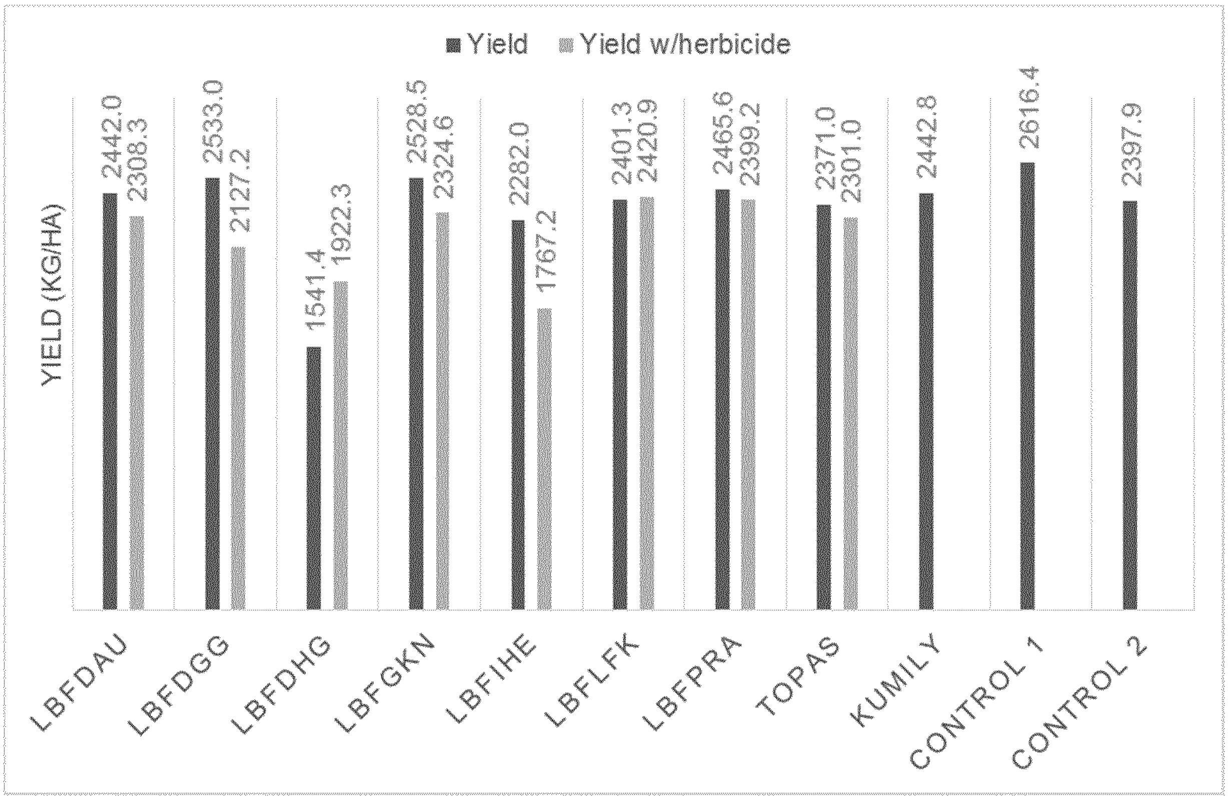

■ Yield ■ Yield w/herbicide
YIELD (KG/HA)
2442.0
2308.3
2533.0
2127.2
1541.4
1922.3
2528.5
2324.6
2282.0
1767.2
2401.3
2420.9
2465.6
2399.2
2371.0
2301.0
2442.8
2616.4
2397.9
LBFDAU
LBFDGG
LBFDHG
LBFGKN
LBFIHE
LBFLFK
LBFPRA
TOPAS
KUMILY
CONTROL 1
CONTROL 2

Fig. 89

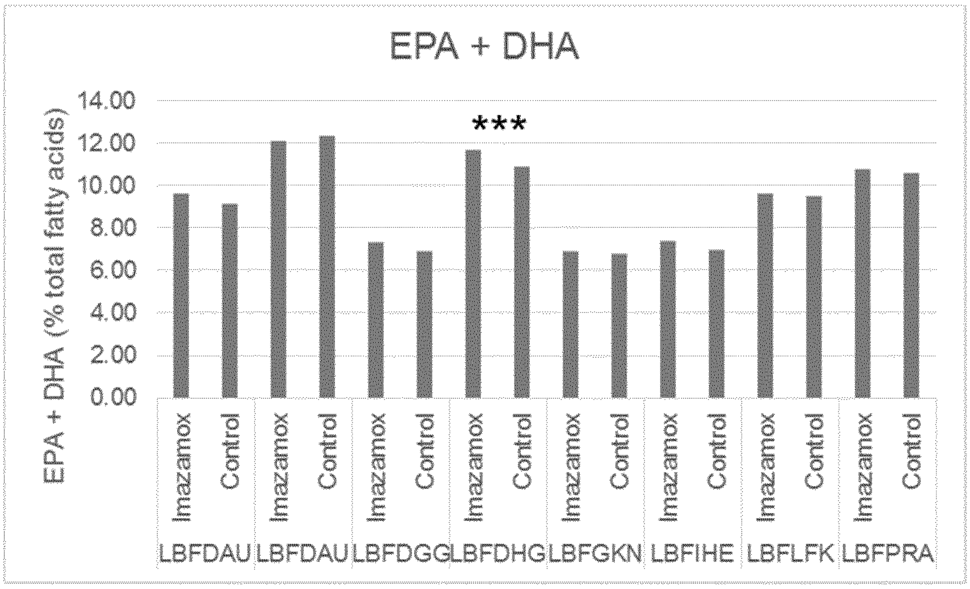

EPA + DHA
EPA + DHA (% total fatty acids)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
***
Imazamox
Control
LBFDAU
LBFDAU
LBFDGG
LBFDHG
LBFGKN
LBFIHE
LBFLFK
LBFPRA

Fig. 90

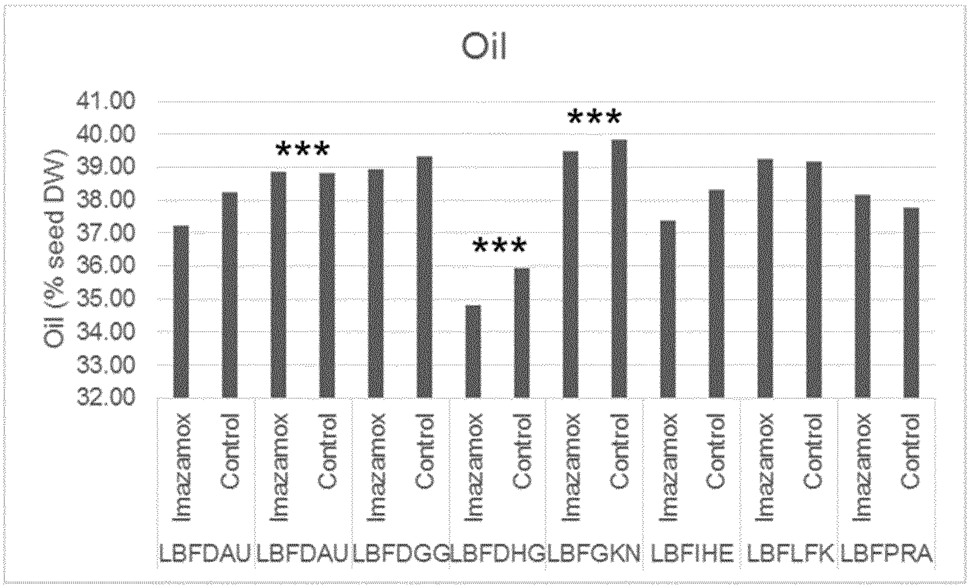
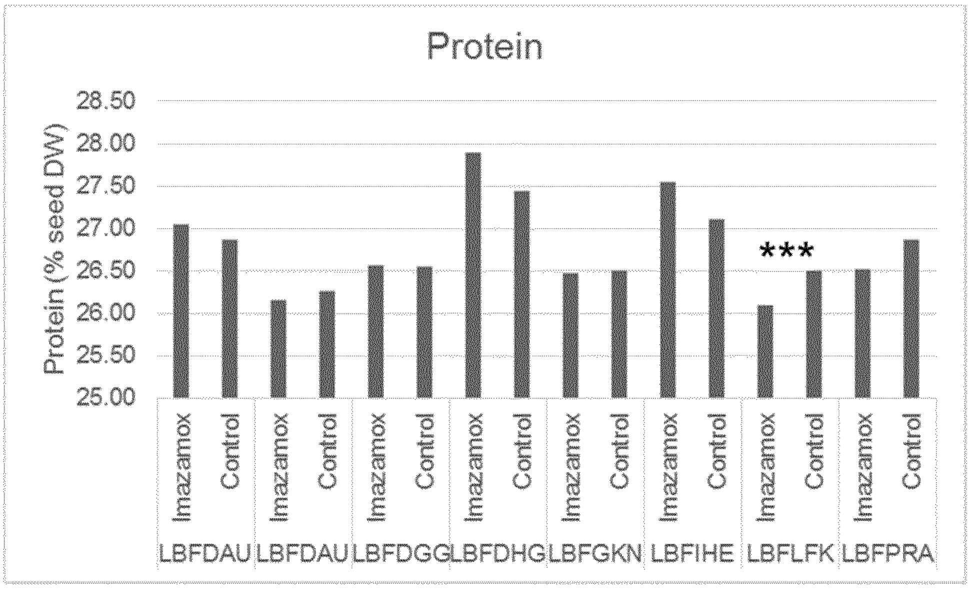

Oil
41.00
40.00
39.00
38.00
37.00
36.00
35.00
34.00
33.00
32.00
Oil (% seed DW)
***
***
***
Imazamox
Control
LBFDAU
LBFDAU
LBFDGG
LBFDHG
LBFGKN
LBFIHE
LBFLFK
LBFPRA

Fig. 91


Protein
Protein (% seed DW)
28.50
28.00
27.50
27.00
26.50
26.00
25.50
25.00
***
Imazamox
Control
LBFDAU
LBFDAU
LBFDGG
LBFDHG
LBFGKN
LBFIHE
LBFLFK
LBFPRA

SEQUENCE LISTING

<110> BASF PLANT SCIENCE COMPANY GMBH
Bioriginal Food & Science Corporation

<120> MATERIALS AND METHODS FOR PUFA PRODUCTION, AND PUFA-CONTAINING COMPOSITIONS

<130> 0000077877WO01

<150> US62/079622
<151> 2014-11-14

<150> US62/234373
<151> 2015-09-29

<160> 336

<170> According WIPO Std. 25

<210> 1
<211> 60097
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 1
cctgccagtc agcatcatca caccaaaagt taggcccgaa tagtttgaaa ttagaaagct 60
cgcaattgag gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg 120
atgcccccca tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac 180
tattacgtaa gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga 240
cgttacgtaa gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga 300
cgttacgtaa cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt 360
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa 420
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag 480
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa 540
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa 600
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac 660
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa 720
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt 780
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca 840
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac 900
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc 960
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtactgttta 1020
agcttcactg tctctgaatc ggcaaaggta aacgtatcaa ttattctaca aacccttttta 1080
tttttctttt gaattaccgt cttcattggt tatatgataa cttgataagt aaagcttcaa 1140
taattgaatt tgatctgtgt ttttttggcc ttaatactaa atccttacat aagctttgtt 1200
gcttctcctc ttgtgagttg agtgttaagt tgtaataatg gttcactttc agctttagaa 1260
gaaaccatgg aagttgttga gaggttctac ggagagttgg atggaaaggt ttcccaagga 1320
gtgaacgctt tgttgggatc tttcggagtt gagttgactg ataccccaac tactaaggga 1380
ttgccactcg ttgattctcc aactccaatt gtgttgggag tgtctgttta cttgaccatc 1440
gtgatcggag gattgctttg gatcaaggct agagatctca agccaagagc ttctgagcca 1500
ttcttgttgc aagctttggt gttggtgcac aacttgttct gcttcgcttt gtctctttac 1560
atgtgcgtgg gtatcgctta ccaagctatc acctggagat attccttgtg gggaaacgct 1620
tataacccaa agcacaagga gatggctatc ctcgtttacc tcttctacat gtccaagtac 1680
gtggagttca tggataccgt gatcatgatc ctcaagagat ccaccagaca gatttctttc 1740
ctccacgtgt accaccactc ttctatctcc cttatctggt gggctattgc tcaccacgct 1800
ccaggaggag aggcttattg gagtgctgct ctcaactctg gagtgcacgt gttgatgtac 1860
gcttactact tcttggctgc ttgcttgaga tcttccccaa agctcaagaa caagtacctc 1920
ttctggggaa gatacctcac ccaattccag atgttccagt tcatgctcaa cttggtgcaa 1980
gcttactacg atatgaaaac caacgctcca tatccacaat ggctcatcaa gatcctcttc 2040
tactacatga tctccctctt gttcctcttc ggaaacttct acgtgcaaaa gtacatcaag 2100
ccatccgatg gaaagcaaaa gggagctaag accgagtgat cgacaagctc gagtttctcc 2160
ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg gtttcgctca 2220
tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata cttctatcaa 2280
taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc ccgaattaat 2340

```
tcggcgttaa ttcagctagc tagcctcagc tgacgttacg taacgctagg tagcgtcacg   2400
tgacgttagc taacgctagg tagcgtcagc tgagcttacg taagcgctta gcagatattt   2460
ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg   2520
gacaacgttg ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca   2580
tgagttgcaa attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg   2640
agagagtctt tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag   2700
tctttttggt gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag   2760
gctgtaaaag attgtaaaag actattttgg tgttttggat aaaatgatag tttttataga   2820
ttcttttgct tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg   2880
aaatcgattg aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt   2940
ctctccattt ttatacctat ttaaccgtaa tcgattctaa tagatgatcg atttttttata   3000
taatcctaat taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat   3060
agaatcagta ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt   3120
tttaattttt ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc   3180
aaggtaagag aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa   3240
atgtacactt gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt   3300
attaaaatac cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa   3360
aagaacccac gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac   3420
tatataaacc caccatcccc aatctcacca aacccaccac acaactcaca actcactctc   3480
acaccttaaa gaaccaatca ccaccaaaaa atttcacgat ttggaatttg attcctgcga   3540
tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt ctttgtgatg   3600
ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga   3660
aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca tgttctttgt   3720
tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt cttactgatc   3780
gttattagga gtttggggaa aaaggaagag tttttttggt tggttcgagt gattatgagg   3840
ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac catgggaaaa   3900
ggatctgagg gaagatctgc tgctagagag atgactgctg aggctaacgg agataagaga   3960
aagaccatcc tcattgaggg agtgttgtac gatgctacca acttcaaaca cccaggaggt   4020
tccattatta acttcctcac cgagggagaa gctggagttg atgctaccca agcttacaga   4080
gagttccatc agagatccgg aaaggctgat aagtacctca agtccctccc aaagttggat   4140
gcttctaagg tggagtctag gttctctgct aaggagcagg ctagaaggga cgctatgacc   4200
agggattacg ctgctttcag agaggagttg gttgctgagg gatacttcga tccatctatc   4260
ccacacatga tctacagagt ggtggagatt gtggctttgt tcgctttgtc tttctggttg   4320
atgtctaagg cttctccaac ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa   4380
ggaagatgcg gatgggttat gcacgagatg ggacacggat ctttcactgg agttatctgg   4440
ctcgatgata ggatgtgcga gttcttctac ggagttggat gtggaatgtc tggacactac   4500
tggaagaacc agcactctaa gcaccacgct gctccaaaca gattggagca cgatgtggat   4560
ttgaacacct tgccactcgt tgctttcaac gagagagttg tgaggaaggt taagccagga   4620
tctttgttgg ctttgtggct cagagttcag gcttatttgt tcgctccagt gtcttgcttg   4680
ttgatcggat tgggatggac cttgtacttg cacccaagat atatgctcag gaccaagaga   4740
cacatggagt ttgtgtggat cttcgctaga tatatcggat ggttctcctt gatgggagct   4800
ttgggatatt ctcctggaac ttctgtggga atgtacctct gctctttcgg acttggatgc   4860
atctacatct tcctccaatt cgctgtgtct cacacccact tgccagttac caacccagag   4920
gatcaattgc actggcttga gtacgctgct gatcacaccg tgaacatctc taccaagtct   4980
tggttggtta cctggtggat gtctaacctc aacttccaaa tcgagcacca cttgttccca   5040
accgctccac aattcaggtt caaggagatc tctccaagag ttgaggctct cttcaagaga   5100
cacaacctcc cttactacga tttgccatac acctctgctg tttctactac cttcgctaac   5160
ctctactctg ttggacactc tgttggagct gataccaaga agcaggattg actgctttaa   5220
tgagatatgc gagacgccta tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt   5280
gtaaaaaacc tgagcatgtg tagctcagat ccttaccgcc ggtttcggtt cattctaatg   5340
aatatatcac ccgttactat cgtattttta tgaataatat tctccgttca atttactgat   5400
tgtctacgta ggctcagctg agcttaccta aggctacgta ggctcacgtg acgttacgta   5460
aggctacgta gcgtcacgtg agcttaccta actctagcta gcctcacgtg accttagcta   5520
acactaggta gcgtcagctc gacggcccgg actgtatcca acttctgatc tttgaatctc   5580
tctgttccaa catgttctga aggagttcta agacttttca gaaagcttgt aacatgcttt   5640
gtagactttc tttgaattac tcttgcaaac tctgattgaa cctacgtgaa aactgctcca   5700
gaagttctaa ccaaattccg tcttgggaag gcccaaaatt tattgagtac ttcagtttca   5760
tggacgtgtc ttcaaagatt tataacttga aatcccatca tttttaagag aagttctgtt   5820
ccgcaatgtc ttagatctca ttgaaatcta caactcttgt gtcagaagtt cttccagaat   5880
caacttgcat catggtgaaa atctggccag aagttctgaa cttgtcatat ttcttaacag   5940
ttagaaaaat ttctaagtgt ttagaatttt gacttttcca aagcaaactt gacttttgac   6000
tttcttaata aaacaaactt catattctaa catgtcttga tgaaatgtga ttcttgaaat   6060
ttgatgttga tgcaaaagtc aaagtttgac ttttcagtgt gcaattgacc attttgctct   6120
tgtgccaatt ccaaacctaa attgatgtat cagtgctgca aacttgatgt catggaagat   6180
cttatgagaa aattcttgaa gactgagagg aaaaatttg tagtacaaca caaagaatcc   6240
tgtttttcat agtcggacta gacacattaa cataaaacac cacttcattc gaagagtgat   6300
tgaagaagga aatgtgcagt tacctttctg cagttcataa gagcaactta cagacacttt   6360
tactaaaata ctacaaagag gaagatttta acaacttaga gaagtaatgg gagttaaaga   6420
```

gcaacacatt aagggggagt gttaaaatta atgtgttgta accaccacta cctttagtaa 6480
gtattataag aaaattgtaa tcatcacatt ataattattg tccttattta aaattatgat 6540
aaagttgtat cattaagatt gagaaaacca aatagtcctc gtcttgattt ttgaattatt 6600
gttttctatg ttacttttct tcaagcctat ataaaaactt tgtaatgcta aattgtatgc 6660
tggaaaaaaa tgtgtaatga attgaataga aattatggta tttcaaagtc caaaatccat 6720
caatagaaat ttagtacaaa acgtaactca aaaatattct cttattttaa attttacaac 6780
aatataaaaa tattctctta ttttaaattt tacaataata taatttatca cctgtcacct 6840
ttagaatacc accaacaata ttaatactta gatattttat tcttaataat tttgagatct 6900
ctcaatatat ctgatattta ttttatattt gtgtcatatt ttcttatgtt ttagagttaa 6960
cccttatatc ttggtcaaac tagtaattca atatatgagt ttgtgaagga cacattgaca 7020
tcttgaaaca ttggttttaa ccttgttgga atgttaaagg taataaaaca ttcagaatta 7080
tgaccatcta ttaatatact tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat 7140
ggtaagctag agtgtcttgc tggcctgtgt atatcaattc catttccaga tggtagaaac 7200
tgccactacg aataattagt cataagacac gtatgttaac acacgtcccc ttgcatgttt 7260
tttgccatat attccgtctc tttctttttc ttcacgtata aaacaatgaa ctaattaata 7320
gagcgatcaa gctgaacagt tctttgcttt cgaagttgcc gcaacctaaa caggtttttc 7380
cttcttcttt cttcttatta actacgacct tgtcctttgc ctatgtaaaa ttactaggtt 7440
ttcatcagtt acactgatta agttcgttat agtggaagat aaaatgccct caaagcattt 7500
tgcaggatat ctttgatttt tcaaagatat ggaactgtag agtttgatag tgttcttgaa 7560
tgtggttgca tgaagttttt ttggtctgca tgttattttt tcctcgaaat atgttttgag 7620
tccaacaagt gattcacttg ggattcagaa agttgtttc tcaatatgta acagtttttt 7680
tctatggaga aaaatcatag ggaccgttgg ttttggcttc tttaattttg agctcagatt 7740
aaacccattt tacccggtgt tcttggcaga attgaaaaca gtacgtagta ccgcgcctac 7800
catgtgtgtt gagaccgaga acaacgatgg aatccctact gtggagatcg ctttcgatgg 7860
agagagagaa agagctgagg ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc 7920
tttggctaag accttcgcta gaagatacgt ggttatcgag ggagttgagt acgatgtgac 7980
cgatttcaaa catcctggag gaaccgtgat ttctacgct ctctctaaca ctggagctga 8040
tgctactgag gctttcaagg agttccacca cagatctaga aaggctagga aggctttggc 8100
tgctttgcct tctagacctg ctaagaccgc taaagtggat gatgctgaga tgctccagga 8160
tttcgctaag tggagaaagg agttggagag ggacggattc ttcaagcctt ctcctgctca 8220
tgttgcttac agattcgctg agttggctgc tatgtacgct ttgggaacct acttgatgta 8280
cgctagatac gttgtgtcct ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg 8340
atgggttcaa cacgagggag gacactcttc tttgaccgga aacatctggt gggataagag 8400
aatccaagct ttcactgctg gattcggatt ggctggatct ggagatatgt ggaactccat 8460
gcacaacaag caccacgcta ctcctcaaaa agtgaggcac gatatggatt tggataccac 8520
tcctgctgtt gctttcttca acaccgctgt ggaggataat agacctaggg gattctctaa 8580
gtactggctc agattgcaag cttggacctt cattcctgtg acttctggat tggtgttgct 8640
cttctggatg ttcttcctcc acccttctaa ggctttgaag ggaggaaagt acgaggagct 8700
tgtgtggatg ttggctgctc acgtgattag aacctggacc attaaggctg ttactggatt 8760
caccgctatg caatcctacg gactcttctt ggctacttct tgggtttccg gatgctactt 8820
gttcgctcac ttctctactt ctcacaccca cttggatgtt gttcctgctg atgagcactt 8880
gtcttgggtt aggtacgctg tggatcacac cattgatatc gatccttctc agggatgggt 8940
taactggttg atgggatact tgaactgcca agtgattcac cacctcttcc cttctatgcc 9000
tcaattcaga caacctgagg tgtccagaag attcgttgct ttcgctaaga agtggaacct 9060
caactacaag gtgatgactt atgctggagc ttggaaggct actttgggaa acctcgataa 9120
tgtgggaaag cactactacg tgcacggaca acactctgga aagaccgctt gattaatgaa 9180
ggccgcctcg accgtacccc ctgcagatag actatactat gttttagcct gcctgctggc 9240
tagctactat gttatgttat gttgtaaaat aaacacctgc taaggtatat ctatctatat 9300
tttagcatgg ctttctcaat aaattgtctt tccttatcgt ttactatctt atacctaata 9360
atgaaataat aatatcacat atgaggaacg gggcaggttt aggcatatat atacgagtgt 9420
agggcggagt ggggctacgt agcgtcacgt gacgttacct aagcctaggt agcctcagct 9480
gacgttacgt aacgctaggt aggctcagct gacacgggca ggacataggg actactacaa 9540
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa 9600
agtgctagag gggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca 9660
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg 9720
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa 9780
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat 9840
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc 9900
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag 9960
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata 10020
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag 10080
atttgtgcat tttgttgaat ataaattgac aatttttttt atttaattat agattattta 10140
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt 10200
aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca 10260
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt 10320
taatcgggta aaacctgatt actaaatata tattttttat ttgataaaca aaacaaaaat 10380
gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt 10440
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat 10500

```
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag  10560
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact  10620
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac  10680
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga  10740
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt  10800
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt  10860
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact  10920
tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata  10980
tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg  11040
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta  11100
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc  11160
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc  11220
gacattttta tcataaatct ggtgcttaaa cactctggtg agttctagta cttctgctat  11280
gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt tcttgatttt  11340
tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt tttttttgtg  11400
gttaatttag tttcctatgt tcttcgattg tattatgcat gatctgtgtt tggattctgt  11460
tagattatgt attggtgaat atgtatgtgt ttttgcatgt ctggttttgg tcttaaaaat  11520
gttcaaatct gatgatttga ttgaagcttt tttagtgttg gtttgattct tctcaaaact  11580
actgttaatt tactatcatg ttttccaact ttgattcatg atgacacttt tgttctgctt  11640
tgttataaaa ttttggttgg tttgattttg taattatagt gtaattttgt taggaatgaa  11700
catgttttaa tactctgttt tcgatttgtc acacattcga attattaatc gataatttaa  11760
ctgaaaattc atggttctag atcttgttgt catcagatta tttgtttcga taattcatca  11820
aatatgtagt ccttttgctg atttgcgact gtttcatttt ttctcaaaat tgtttttttgt  11880
taagtttatc taacagttat cgttgtcaaa agtctctttc attttgcaaa atcttctttt  11940
tttttttgtt tgtaactttg ttttttaagc tacacattta gtctgtaaaa tagcatcgag  12000
gaacagttgt cttagtagac ttgcatgttc ttgtaacttc tatttgtttc agtttgttga  12060
tgactgcttt gattttgtag gtcaaaggcg caccctacca tggatgctta taacgctgct  12120
atggataaga ttggagctgc tatcatcgat tggagtgatc cagatggaaa gttcagagct  12180
gatagggagg attggtggtt gtgcgatttc agatccgcta tcaccattgc tctcatctac  12240
atcgctttcg tgatcttggg atctgctgtg atgcaatctc tcccagctat ggacccatac  12300
cctatcaagt tcctctacaa cgtgtctcaa atcttcctct gcgcttacat gactgttgag  12360
gctggattcc tcgcttatag gaacggatac accgttatgc catgcaacca cttcaacgtg  12420
aacgatccac cagttgctaa cttgctctgg ctcttctaca tctccaaagt gtgggatttc  12480
tgggatacca tcttcattgt gctcggaaag aagtggagac aactctcttt cttgcacgtg  12540
taccaccaca ccaccatctt cctcttctac tggttgaacg ctaacgtgct ctacgatgga  12600
gatatcttct tgaccatcct cctcaacgga ttcattcaca ccgtgatgta cacctactac  12660
ttcatctgca tgcacaccaa ggattctaag accggaaagt ctttgccaat ctggtggaag  12720
tcatctttga ccgctttcca actcttgcaa ttcaccatca tgatgtccca agctacctac  12780
ttggttttcc acggatgcga taaggtttcc ctcagaatca ccatcgtgta cttcgtgtac  12840
attctctccc ttttcttcct cttcgctcag ttcttcgtgc aatcctacat ggctccaaag  12900
aagaagaagt ccgcttgatg ttaatgaagg ccgcagatat cagatctggt cgacctagag  12960
gatccccggc cgcaaagata ataacaaaag cctactatat aacgtacatg caagtattgt  13020
atgatattaa tgtttttacg tacgtgtaaa caaaaataat tacgtttgta acgtatggtg  13080
atgatgtggt gcactaggtg taggccttgt attaataaaa agaagtttgt tctatataga  13140
gtggtttagt acgacgattt atttactagt cggattggaa tagagaaccg aattcttcaa  13200
tccttgcttt tgatcaagaa ttgaaaccga atcaaatgta aaagttgata tatttgaaaa  13260
acgtattgag cttatgaaaa tgctaatact ctcatctgta tggaaaagtg actttaaaac  13320
cgaacttaaa agtgacaaaa ggggaatatc gcatcaaacc gaatgaaacc gatctacgta  13380
ggctcagctg agcttagcta agcctaccta gcctcacgtg agattatgta aggctaggta  13440
gcgtcacgtg acgttaccta acactagcta gcgtcagctg agcttagcta accctacgta  13500
gcctcacgtg agcttaccta acgctacgta gcctcacgtg actaaggatg acctacccat  13560
tcttgagaca aatgttacat tttagtatca gagtaaaatg tgtacctata actcaaattc  13620
gattgacatg tatccattca acataaaatt aaaccagcct gcacctgcat ccacatttca  13680
agtattttca aaccgttcgg ctcctatcca ccgggtgtaa caagacggat tccgaatttg  13740
gaagattttg actcaaattc ccaatttata ttgaccgtga ctaaatcaac tttaacttct  13800
ataattctga ttaagctccc aatttatatt cccaacggca ctacctccaa aatttataga  13860
ctctcatccc cttttaaacc aacttagtaa acgttttttt tttaatttta tgaagttaag  13920
tttttacctt gtttttaaaa agaatcgttc ataagatgcc atgccagaac attagctaca  13980
cgttacacat agcatgcagc cgcggagaat tgtttttctt cgccacttgt cactcccttc  14040
aaacacctaa gagcttctct ctcacagcac acacatacaa tcacatgcgt gcatgcatta  14100
ttacacgtga tcgccatgca aatctccttt atagcctata aattaactca tcggcttcac  14160
tctttactca aaccaaaact catcaataca aacaagatta aaaacatttc acgatttgga  14220
atttgattcc tgcgatcaca ggtatgacag gttagatttt gttttgtata gttgtataca  14280
tacttctttg tgatgttttg tttacttaat cgaatttttg gagtgtttta aggtctctcg  14340
tttagaaatc gtggaaaata tcactgtgtg tgtgttctta tgattcacag tgtttatggg  14400
tttcatgttc tttgttttat cattgaatgg gaagaaattt cgttgggata caaatttctc  14460
atgttcttac tgatcgttat taggagtttg gggaaaaagg aagagttttt ttggttggtt  14520
cgagtgatta tgaggttatt tctgtatttg atttatgagt taatggtcgt tttaatgttg  14580
```

tagaccgcca tggctatttt gaaccctgag gctgattctg ctgctaacct cgctactgat 14640
tctgaggcta agcaaagaca attggctgag gctggataca ctcacgttga gggtgctcct 14700
gctcctttgc ctttggagtt gcctcacttc tctctcagag atctcagagc tgctattcct 14760
aagcactgct tcgagagatc tttcgtgacc tccacctact acatgatcaa gaacgtgttg 14820
acttgcgctg ctttgttcta cgctgctacc ttcattgata gagctggagc tgctgcttat 14880
gttttgtggc ctgtgtactg gttcttccag ggatcttact tgactggagt gtgggttatc 14940
gctcacgagt gtggacacca ggcttattgc tcttctgagg tggtgaacaa cttgattgga 15000
ctcgtgttgc actctgcttt gttggtgcct taccactctt ggagaatctc tcacagaaag 15060
caccactcca acactggatc ttgcgagaac gatgaggttt tcgttcctgt gaccagatct 15120
gtgttggctt cttcttggaa cgagaccttg gaggattctc ctctctacca actctaccgt 15180
atcgtgtaca tgttggttgt tggatggatg cctggatacc tcttcttcaa cgctactgga 15240
cctactaagt actggggaaa gtctaggtct cacttcaacc cttactccgc tatctatgct 15300
gatagggaga ggtggatgat cgtgctctcc gatattttct tggtggctat gttggctgtt 15360
ttggctgctt tggtgcacac tttctccttc aacacgatgg tgaagttcta cgtggtgcct 15420
tacttcattg tgaacgctta cttggtgttg attacctacc tccaacacac cgatacctac 15480
atccctcact tcagagaggg agagtggaat tggttgagag gagctttgtg cactgtggat 15540
agatcatttg gtccattcct cgattctgtg gtgcatagaa tcgtggatac ccacgtttgc 15600
caccatatct tctccaagat gcctttctat cactgcgagg aggctaccaa cgctattaag 15660
cctctcctcg gaaagttcta cttgaaggat actactcctg ttcctgttgc tctctggaga 15720
tcttacaccc actgcaagtt cgttgaggat gatggaaagg tggtgttcta caagaacaag 15780
ttatagttaa tgaataattg attggttcga gtattatggc attgggaaaa ctgtttttct 15840
tgtaccattt gttgtgcttg taatttactg tgttttttat tcggttttcg ctatcgaact 15900
gtgaaatgga aatggatgga gaagagttaa tgaatgatat ggtccttttg ttcattctca 15960
aattaatatt atttgttttt tctcttattt gttgtgtgtt gaatttgaaa ttataagaga 16020
tatgcaaaca ttttgttttg agtaaaaatg tgtcaaatcg tggcctctaa tgaccgaagt 16080
taatatgagg agtaaaacac ttgtagttgt accattatgc ttattcacta ggcaacaaat 16140
atattttcag acctagaaaa gctgcaaatg ttactgaata caagtatgtc ctcttgtgtt 16200
ttagacattt atgaactttc ctttatgtaa ttttccagaa tccttgtcag attctaatca 16260
ttgctttata attatagtta tactcatgga tttgtagttg agtatgaaaa tattttttaa 16320
tgcattttat gacttgccaa ttgattgaca acatgcatca atgcggccgc tagctagcct 16380
cagctgacgt tacgtaacgc taggtagcgt cacgtgacgt tagctaacgc taggtagcgt 16440
cagctgagct tacgtaagcg ccacgggcag gacataggga ctactacaag catagtatgc 16500
ttcagacaaa gagctaggaa agaactcttg atggaggtta agagaaaaaa gtgctagagg 16560
ggcatagtaa tcaaacttgt caaaaccgtc atcatgatga gggatgacat aatataaaaa 16620
gttgactaag gtcttggtag tactctttga ttagtattat atattggtga gaacatgagt 16680
caagaggaga caagaaaccg aggaaccata gtttagcaac aagatggaag ttgcaaagtt 16740
gagctagccg ctcgattagt tacatctcct aagcagtact acaaggaatg gtctctatac 16800
tttcatgttt agcacatggt agtgcggatt gacaagttag aaacagtgct taggagacaa 16860
agagtcagta aaggtattga aagagtgaag ttgatgctcg acaggtcagg agaagtccct 16920
ccgccagatg gtgactacca aggggttggt atcagctgag acccaaataa gattcttcgg 16980
ttgaaccagt ggttcgaccg agactcttag ggtgggattt cactgtaaga tttgtgcatt 17040
ttgttgaata taaattgaca attttttttta tttaattata gattatttag aatgaattac 17100
atatttagtt tctaacaagg atagcaatgg atgggtatgg gtacaggtta aacatatcta 17160
ttacccaccc atctagtcgt cgggttttac acgtacccac ccgtttacat aaaccagacc 17220
ggaattttaa accgtacccg tccgttagcg ggtttcagat ttacccgttt aatcgggtaa 17280
aacctgatta ctaaatatat attttttatt tgataaacaa aacaaaaatg ttaatatttt 17340
catattggat gcaattttaa gaaacacata ttcataaatt tccatatttg taggaaaata 17400
aaaagaaaaa tatattcaag aacacaaatt tcaccgacat gacttttatt acagagttgg 17460
aattagatct aacaattgaa aaattaaaat taagatagaa tatgttgagg aacatgacat 17520
agtataatgc tgggttaccc gtcgggtagg tatcgaggcg gatactacta aatccatccc 17580
actcgctatc cgataatcac tggtttcggg tatacccatt cccgtcaaca ggccttttta 17640
accggataat ttcaacttat agtgaatgaa ttttgaataa atagttagaa taccaaaatc 17700
ctggattgca tttgcaatca aattttgtga accgttaaat tttgcatgta cttgggatag 17760
atataataga accgaatttt cattagttta atttataact tactttgttc aaagaaaaaa 17820
aatatctatc caatttactt ataataaaaa ataatctatc caagttactt attataatca 17880
acttgtaaaa aggtaagaat acaaatgtgg tagcgtacgt gtgattatat gtgacgaaat 17940
gttatatcta acaaaagtcc aaattcccat ggtaaaaaaa atcaaaatgc atggcaggct 18000
gtttgtaacc ttggaataag atgttggcca attctggagc cgccacgtac gcaagactca 18060
gggccacgtt ctcttcatgc aaggatagta gaacaccact ccacccacct cctatattag 18120
acctttgccc aaccctcccc aactttccca tcccatccac aaagaaaccg acatttttat 18180
cataaatcag ggtttcgttt ttgtttcatc gataaactca aaggtgatga ttttagggtc 18240
ttgtgagtgt gctttttttgt ttgattctac tgtagggttt atgttcttta gctcataggt 18300
tttgtgtatt tcttagaaat gtggcttctt taatctctgg gtttgtgact ttttgtgtgg 18360
tttctgtgtt tttcatatca aaaacctatt ttttccgagt tttttttttac aaattcttac 18420
tctcaagctt gaatacttca catgcagtgt tcttttgtag attttagagt taatgtgtta 18480
aaaagtttgg atttttcttg cttatagagc ttcttcactt tgattttgtg ggtttttttg 18540
ttttaaaggt gagattttttg atgaggtttt tgcttcaaag atgtcacctt tctgggtttg 18600
tcttttgaat aaagctatga actgtcacat ggctgacgca atttgttac tatgtcatga 18660

aagctgacgt ttttccgtgt tatacatgtt tgcttacact tgcatgcgtc aaaaaaattg 18720
gggcttttta gttttagtca aagattttac ttctcttttg ggatttatga aggaaagttg 18780
caaactttct caaattttac catttttgct ttgatgtttg tttagattgc gacagaacaa 18840
actcatatat gttgaaattt ttgcttggtt ttgtatagga ttgtgtcttt tgcttataaa 18900
tgttgaaatc tgaacttttt ttttgtttgg tttctttgag caggagataa ggcgcaccac 18960
catggcttct acatctgctg ctcaagacgc tgctccttac gagttccctt ctctcactga 19020
gatcaagagg gctcttcctt ctgagtgttt cgaggcttct gttcctcttt ctctctacta 19080
caccgctaga tctcttgctc ttgctggatc tctcgctgtt gctctctctt acgctagagc 19140
tttgcctctt gttcaggcta acgctcttct tgatgctact ctctgcactg gatacgttct 19200
tctccaggga atcgttttct ggggattctt caccgttggt cacgattgtg gacacggagc 19260
tttctctaga tctcacgtgc tcaacttctc tgttggaacc ctcatgcact ctatcatcct 19320
tacccctttc gagtcttgga agctctctca cagacaccac cacaagaaca ccggaaacat 19380
cgataaggac gagatcttct accctcaaag agaggctgat tctcaccctg tttctagaca 19440
ccttgtgatg tctcttggat ctgcttggtt cgcttacctt ttcgctggat tccctcctag 19500
aaccatgaac cacttcaacc cttgggaggc tatgtatgtt agaagagtgg ctgctgtgat 19560
catctctctc ggagttcttt tcgctttcgc tggactctac tcttacctca ccttcgttct 19620
tggattcacc actatggcta tctactactt cggacctctc ttcatcttcg ctaccatgct 19680
tgttgttacc actttcctcc accacaacga tgaggagaca ccttggtacg ctgattctga 19740
gtggacttac gtgaagggaa acctctcttc tgtggacaga tcttacggtg ctctcatcga 19800
caaccttagc cacaacatcg gaactcacca gatccaccac ctcttcccta tcatccctca 19860
ctacaagctc aacgatgcta ctgctgcttt cgctaaggct ttccctgagc ttgttaggaa 19920
aaacgctgct cctatcatcc caactttctt caggatggct gctatgtacg ctaagtacgg 19980
agttgttgac actgatgcta agaccttcac tctcaaggag gctaaggctg ctgctaagac 20040
taagtcatct tgatgattaa tgaaggccgc agatatcaga tctggtcgac ctagaggatc 20100
cccggccgca aagataataa caaaagccta ctatataacg tacatgcaag tattgtatga 20160
tattaatgtt tttacgtacg tgtaaacaaa aataattacg tttgtaacgt atggtgatga 20220
tgtggtgcac taggtgtagg ccttgtatta ataaaaagaa gtttgttcta tatagagtgg 20280
tttagtacga cgatttattt actagtcgga ttggaataga gaaccgaatt cttcaatcct 20340
tgcttttgat caagaattga aaccgaatca aatgtaaaag ttgatatatt tgaaaaacgt 20400
attgagctta tgaaaatgct aatactctca tctgtatgga aaagtgactt taaaaccgaa 20460
cttaaaagtg acaaaagggg aatatcgcat caaaccgaat gaaaccgatc tacgtaggct 20520
cagctgagct tacctaaggc tacgtaggct cacgtgacgt tacgtaaggc tacgtagcgt 20580
cacgtgagct tacctaactc tagctagcct cacgtgacct tagctaacac taggtagcgt 20640
cagcttagca gatatttggt gtctaaatgt ttattttgtg atatgttcat gtttgaaatg 20700
gtggtttcga aaccagggac aacgttggga tctgataggg tgtcaaagag tattatggat 20760
tgggacaatt tcggtcatga gttgcaaatt caagtatatc gttcgattat gaaaatttc 20820
gaagaatatc ccatttgaga gagtctttac ctcattaatg tttttagatt atgaaatttt 20880
atcatagttc atcgtagtct ttttggtgta aaggctgtaa aaagaaattg ttcacttttg 20940
ttttcgttta tgtgaaggct gtaaaagatt gtaaaagact attttggtgt tttggataaa 21000
atgatagttt ttatagattc ttttgctttt agaagaaata catttgaaat tttttccatg 21060
ttgagtataa aataccgaaa tcgattgaag atcatagaaa tattttaact gaaaacaaat 21120
ttataactga ttcaattctc tccattttta tacctattta accgtaatcg attctaatag 21180
atgatcgatt ttttatataa tcctaattaa ccaacggcat gtattggata attaaccgat 21240
caactctcac ccctaataga atcagtattt tccttcgacg ttaattgatc ctacactatg 21300
taggtcatat ccatcgtttt aatttttggc caccattcaa ttctgtcttg cctttaggga 21360
tgtgaatatg aacggccaag gtaagagaat aaaaataatc caaattaaag caagagaggc 21420
caagtaagat aatccaaatg tacacttgtc attgccaaaa ttagtaaaat actcggcata 21480
ttgtattccc acacattatt aaaataccgt atatgtattg gctgcatttg catgaataat 21540
actacgtgta agcccaaaag aacccacgtg tagcccatgc aaagttaaca ctcacgaccc 21600
cattcctcag tctccactat ataaacccac catccccaat ctcaccaaac ccaccacaca 21660
actcacaact cactctcaca ccttaaagaa ccaatcacca ccaaaaaaag ttctttgctt 21720
tcgaagttgc cgcaacctaa acaggttttt ccttcttctt tcttcttatt aactacgacc 21780
ttgtcctttg cctatgtaaa attactaggt tttcatcagt tacactgatt aagttcgtta 21840
tagtggaaga taaaatgccc tcaaagcatt ttgcaggata tctttgattt ttcaaagata 21900
tggaactgta gagtttgata gtgttcttga atgtggttgc atgaagtttt tttggtctgc 21960
atgttatttt ttcctcgaaa tatgttttga gtccaacaag tgattcactt gggattcaga 22020
aagttgtttt ctcaatatgt aacagttttt ttctatggag aaaaatcata gggaccgttg 22080
gttttggctt ctttaatttt gagctcagat taaacccatt ttacccggtg ttcttggcag 22140
aattgaaaac agtacgtagt accatttaaa tgcgcctacc atgccaccta gtgctgctag 22200
tgaaggtggt gttgctgaac ttagagctgc tgaagttgct agctacacta gaaaggctgt 22260
tgacgaaaga cctgacctca ctatagttgg tgacgctgtt tacgacgcta aggcttttag 22320
ggacgagcac cctggtggtg ctcacttcgt tagccttttc ggaggtaggg acgctactga 22380
ggcttttatg gaatatcacc gtagagcttg gcctaaggct aggatgtcta agttcttcgt 22440
tggttcactt gacgctagcg agaagcctac tcaagctgat tcagcttacc ttagactttg 22500
cgctgaggtt aacgctcttt tgcctaaggg tagcggagga ttcgctcctc ctagctactg 22560
gcttaaggct gctgctcttg ttgttgctgc tgttagtata gagggttata tgctccttag 22620
gggtaagacc cttttgctta gcgttttcct tggactcgtg ttcgcttgga taggacttaa 22680
tattcagcac gacgctaatc acggtgctct tagtagacac tcagtgatta actactgcct 22740

```
cggttacgct caggattgga taggtggtaa tatggtgctt tggcttcaag agcacgttgt  22800
gatgcaccac ctccacacta acgacgttga cgctgatcct gatcaaaagg ctcacggtgt  22860
tcttagactt aagcctactg acggttggat gccttggcac gcacttcaac aactctatat  22920
ccttcctggt gaggctatgt acgcttttaa gcttcttttc ttggacgccc ttgagcttct  22980
tgcttggagg tgggagggtg agaagattag ccctcttgct agagctttgt tcgctcctgc  23040
tgttgcttgt aagcttggat tctgggctag attcgttgct ctccctctct ggcttcaacc  23100
tactgttcac actgctttgt gtatctgtgc tactgtgtgt actggtagct tctacctcgc  23160
cttcttcttc tttatctctc acaacttcga cggtgttggt agcgttggac ctaagggatc  23220
acttcctaga tcagctactt tcgttcaacg tcaggttgag actagctcta acgttggtgg  23280
ttactggctt ggagttctta acggtggact taactttcag atagagcacc acttgttccc  23340
taggcttcac cactcttact acgctcaaat agctcctgtg gttaggactc acatagagaa  23400
gctcggtttt aagtaccgtc acttccctac cgttggatct aaccttagct caatgcttca  23460
gcatatgggt aagatgggaa ctagacctgg tgctgagaag ggtggtaagg ctgagtagtg  23520
attaatgaat aattgattgc tgctttaatg agatatgcga gacgcctatg atcgcatgat  23580
atttgctttc aattctgttg tgcacgttgt aaaaaacctg agcatgtgta gctcagatcc  23640
ttaccgccgg tttcggttca ttctaatgaa tatatcaccc gttactatcg tatttttatg  23700
aataatattc tccgttcaat ttactgattg tctacgtagc gtcacctgac gttacgtaag  23760
gctacctagg ctcacgtgac gttacgtaac gctacgtagc gtcaggtgag gttagctaac  23820
gctagctagc ctcacctgac gttaggtaag gctacgtagc gtcacctgag attagctaag  23880
cctacctaga ctcacgtgac cttaggtaac gctacgtagc gtcaaagctt tacaacgcta  23940
cacaaaactt ataaccgtaa tcaccattca ttaacttaac tactatcaca tgcattcatg  24000
aattgaaacg agaaggatgt aaatagttgg gaagttatct ccacgttgaa gagatcgtta  24060
gcgagagctg aaagaccgag ggaggagacg ccgtcaacac ggacagagtc gtcgaccctc  24120
acatgaagta ggaggaatct ccgtgaggag ccagagagac gtctttggtc ttcggtttcg  24180
atccttgatc tgacggagaa gacgagagaa gtgcgactgg actccgtgag gaccaacaga  24240
gtcgtcctcg gtttcgatcg tcggtattgg tggagaaggc ggaggaatct ccgtgacgag  24300
ccagagagat gtcgtcggtc ttcggtttcg atccttgatc tgacggagaa gacgagagaa  24360
gtgcgacgag actccgtgag gaccaacaga gttgtcctcg gtttcgatcg tcggtttcgg  24420
cggagaaggc ggaggaatct ccgtgaggag ccagagagac gtcgttggtc ttcggtttcg  24480
atccttgatc tgttggagaa gacgagacaa gtgggacgag actcaacgac ggagtcagag  24540
acgtcgtcgg tcttcggttt cggccgagaa ggcggagtcg gtcttcggtt tcggccgaga  24600
aggcggagga gacgtcttcg atttgggtct ctcctcttga cgaagaaaac aaagaacacg  24660
agaaataatg agaaagagaa caaaagaaaa aaaaataaaa ataaaaataa aatttggtcc  24720
tcttatgtgg tgacacgtgg tttgaaaccc accaaataat cgatcacaaa aaacctaagt  24780
taaggatcgg taataacctt tctaattaat tttgatttat attaaatcac tctttttatt  24840
tataaacccc actaaattat gcgatattga ttgtctaagt acaaaaattc tctcgaattc  24900
aatacacatg tttcatatat ttagccctgt tcatttaata ttactagcgc atttttaatt  24960
taaaattttg taaacttttt tggtcaaaga acattttttt aattagagac agaaatctag  25020
actctttatt tggaataata gtaataaaga tatattaggc aatgagttta tgatgttatg  25080
tttatatagt ttatttcatt ttaaattgaa aagcattatt tttatcgaaa tgaatctagt  25140
atacaatcaa tatttatgtt ttttcatcag atactttcct attttttggc acctttcatc  25200
ggactactga tttatttcaa tgtgtatgca tgcatgagca tgagtataca catgtctttt  25260
aaaatgcatg taaagcgtaa cggaccacaa aagaggatcc atacaaatac atctcatcgc  25320
ttcctctact attctccgac acacacactg agcatggtgc ttaaacactc tggtgagttc  25380
tagtacttct gctatgatcg atctcattac catttcttaa atttctctcc ctaaatattc  25440
cgagttcttg atttttgata acttcaggtt ttctcttttt gataaatctg gtctttccat  25500
tttttttttt tttgtggtta atttagtttc ctatgttctt cgattgtatt atgcatgatc  25560
tgtgtttgga ttctgttaga ttatgtattg gtgaatatgt atgtgttttt gcatgtctgg  25620
ttttggtctt aaaaatgttc aaatctgatg atttgattga agctttttta gtgttggttt  25680
gattcttctc aaaactactg ttaatttact atcatgtttt ccaactttga ttcatgatga  25740
cacttttgtt ctgctttgtt ataaaatttt ggttggtttg atttgtaat tatagtgtaa  25800
ttttgttagg aatgaacatg ttttaatact ctgttttcga tttgtcacac attcgaatta  25860
ttaatcgata atttaactga aaattcatgg ttctagatct tgttgtcatc agattatttg  25920
tttcgataat tcatcaaata tgtagtcctt ttgctgattt gcgactgttt catttttcct  25980
caaaattgtt ttttgttaag tttatctaac agttatcgtt gtcaaaagtc tctttcattt  26040
tgcaaaatct tctttttttt tttgtttgta actttgtttt ttaagctaca catttagtct  26100
gtaaaatagc atcgaggaac agttgtctta gtagacttgc atgttcttgt aacttctatt  26160
tgtttcagtt tgttgatgac tgctttgatt ttgtaggtca aaccgcgcca tgtctgctag  26220
cggagctttg ttgcctgcta tagctttcgc tgcttacgct tacgctacct acgcttatgc  26280
tttcgagtgg agccacgcta acggaatcga taacgtggat gctagagagt ggattggagc  26340
tttgtctttg agactccctg caattgcaac cacaatgtac ctcttgttct gccttgtggg  26400
acctagattg atggctaaga gggaggcttt tgatcctaag ggatttatgc tcgcttacaa  26460
cgcttaccaa accgctttca acgttgtggt gctcggaatg ttcgctagag agatctctgg  26520
attgggacaa cctgtttggg gatctactat gccttggagc gataggaagt ccttcaagat  26580
tttgttggga gtgtggctcc actacaacaa taagtacctc gagttgttgg atactgtgtt  26640
catggtggct aggaaaaaga ccaagcagct ctctttcttg cacgtgtacc accacgcttt  26700
gttgatttgg gcttggtggc ttgtttgtca cctcatggct accaacgatt gcatcgatgc  26760
ttatttcgga gctgcttgca actctttcat ccacatcgtg atgtactcct actacctcat  26820
```

gtctgctttg ggaattaggt gcccttggaa gagatatatc acccaggctc agatgttgca 26880
attcgtgatc gtgttcgctc acgctgtttt cgtgctcaga caaaagcact gccctgttac 26940
tttgccttgg gcacaaatgt tcgtgatgac aaatatgttg gtgctcttcg gaaacttcta 27000
cctcaaggct tactctaaca agtctagggg agatggagct tcttctgtta agcctgctga 27060
gactactaga gcaccttctg tgagaagaac caggtcaagg aagatcgatt gatagttaat 27120
gaactaagtt tgatgtatct gagtgccaac gtttactttg tctttccttt cttttattgg 27180
ttatgattag atgtttacta tgttctctct ttttcgttat aaataaagaa gttcaattct 27240
tctatagttt caaacgcgat tttaagcgtt tctatttagg tttacatgat ttcttttaca 27300
aaatcatctt taaaatacag tatattttta gttttcataa aatatttaaa gaaatgaaag 27360
tttataaaca ttcactccta ttctctaatt aaggatttgt aaaacaaaaa ttttgtaagc 27420
atatcgattt atgcgttttg tcttaattag ctcactaaat aataaataat agcttatgtt 27480
gtgggactgt ttaattacct aacttagaac taaaatcaac tctttgtgac gcgtctacct 27540
agagtcagct gagcttagct aacgctagct agtgtcagct gacgttacgt aaggctaact 27600
agcgtcacgt gaccttacgt aacgctacgt aggctcagct gagcttagct aaccctagct 27660
agtgtcacgt gagcttacgc tactatagaa aatgtgttat atcgacatga ccagacaaag 27720
gggcaacagt taacaaaaca attaattctt tcatttgaga ttaaggaagg taaggtacta 27780
aaaagattaa aaaaaatgag cttatctctt tgtttctgta ataataatat aagtgtgata 27840
aacttttaat ataataattg taattaggtt ttctacagat gagcaccact cagagacaag 27900
ataagaagaa aacaatttg ttaaacatga ttatagaaac ttttagttaa gtcttgaagt 27960
atcaatataa caaaaaaaag tacacacgac tatgacaata aacccactac cgtcaggtta 28020
tcatttcgat gaaatgtttt gatatcatta aatataacag tcacaaaaaa tcatctaatt 28080
ataacaatat aacttataca tatatttaac taaaaactta gagtttttgt aatgattcta 28140
attgatgatt agagtttata gaaatacaat taaataaaaa atataatttt aaaaaaacat 28200
agtaaagtca atgagatcct ctctgacctc agtgatcatt tagtcatgta tgtacaacaa 28260
tcattgttca tcacatgact gtaaaataaa taaggataaa cttgggaata tatataatat 28320
attgtattaa ataaaaaagg gaaatacaaa tatcaatttt agattcccga gttgacacaa 28380
ctcaccatgc acgctgccac ctcagctccc agctctcgtc acatgtctca tgtcagttag 28440
gtctttggtt tttagtcttt gacacaactc gccatgcatg ttgccacgtg agctcgttcc 28500
tcttcccatg atctcaccac tgggcatgca tgctgccacc tcagctggca cctcttctct 28560
atatgtccct agaggccatg cacagtgcca cctcagcact cctctcagaa cccatacgta 28620
cctgccaatc ggcttctctc cataaatatc tatttaaatt ataactaatt atttcatata 28680
cttaattgat gacgtggatg cattgccatc gttgtttaat aattgttaat tacgacatga 28740
taaataaaat gaaagtaaaa agtacgaaag attttccatt tgttgttgta taaatagaga 28800
agtgagtgat gcataatgca tgaatgcatg accgcgccac catgactgtt ggatacgacg 28860
aggagatccc attcgagcaa gttagggctc ataacaagcc agacgacgct tggtgtgcta 28920
ttcacggaca cgtgtacgac gttaccaagt tcgcttcagt tcacccagga ggagatatta 28980
tcttgctcgc tgctggaaag gaagctactg tcctctacga gacctaccat gttagaggag 29040
tgtctgacgc tgtgctcaga aagtacagaa taggaaagtt gccagacgga caaggaggag 29100
ctaacgagaa ggagaagaga accttgtctg gattgtcctc tgcttcttac tacacctgga 29160
actccgattt ctacagagtg atgagggaga gagttgtggc tagattgaag gagagaggaa 29220
aggctagaag aggaggatac gaactctgga tcaaggcttt cttgctcctt gttggattct 29280
ggtcctctct ttactggatg tgcaccctcg atccatcttt cggagctatc ttggctgcta 29340
tgtctttggg agtgttcgct gcttttgttg gaacctgcat ccaacacgat ggaaaccacg 29400
gagctttcgc tcaatctaga tgggttaaca aggtggcagg atggactttg gatatgatcg 29460
gagcttctgg aatgacttgg gagttccaac acgtgttggg acaccaccca tacactaact 29520
tgatcgagga ggagaacgga ttgcaaaagg tgtccggaaa gaagatggat accaagttgg 29580
ctgatcaaga gtctgatcca gatgtgttct ccacctaccc aatgatgaga ttgcaccctt 29640
ggcaccagaa gaggtggtat cacaggttcc agcacatcta cggacctttc atcttcggat 29700
tcatgaccat caacaaggtg gtgactcaag atgttggagt ggtgttgaga aagagactct 29760
tccaaatcga tgctgagtgc agatatgctt ccccaatgta cgttgctagg ttctggatta 29820
tgaaggcttt gaccgtgttg tatatggttg ctttgccttg ttatatgcaa ggaccttggc 29880
acggattgaa actcttcgct atcgctcact tcacttgcgg agaggttttg gctaccatgt 29940
tcatcgtgaa ccacattatc gagggagtgt cttacgcttc taaggatgct gttaagggaa 30000
ctatggctcc accaaagact atgcacggag tgaccccaat gaacaacact agaaaggagg 30060
ttgaggctga ggcttctaag tctggagctg tggttaagtc tgtgccattg gatgattggg 30120
ctgctgttca gtgccaaacc tctgtgaact ggtctgttgg atcttggttt tggaaccact 30180
tctctggagg actcaaccac caaatcgagc accacctctt cccaggattg tctcacgaga 30240
cctactacca catccaagac gtggttcaat ctacctgtgc tgagtacgga gttccatacc 30300
aacacgagcc atctttgtgg actgcttact ggaagatgct cgaacacctt agacaattgg 30360
gaaacgagga gactcacgag tcatggcaga gagctgcttg attaatgaac taagactccc 30420
aaaaccacct tccctgtgac agttaaaccc tgcttatacc tttcctccta ataatgttca 30480
tctgtcacac aaactaaaat aaataaaatg ggagcaataa ataaaatggg agctcatata 30540
tttacaccat ttacactgtc tattattcac catgccaatt attacttcat aattttaaaa 30600
ttatgtcatt tttaaaaatt gcttaatgat ggaaaggatt attataagtt aaaagtataa 30660
catagataaa ctaaccacaa aacaaatcaa tataaactaa cttactctcc catctaattt 30720
ttatttaaat ttctttacac ttctcttcca tttctatttc tacaacatta tttaacattt 30780
ttattgtatt tttcttactt tctaactcta ttcatttcaa aaatcaatat atgtttatca 30840
ccacctctct aaaaaaaact ttacaatcat tggtccagaa aagttaaatc acgagatggt 30900

cattttagca ttaaaacaac gattcttgta tcactatttt tcagcatgta gtccattctc 30960
ttcaaacaaa gacagcggct atataatcgt tgtgttatat tcagtctaaa acaactacgt 31020
agcgtcacgt gacgttacct aagcctaggt agcctcagct gacgttacgt aacgctaggt 31080
aggctcagct gactgcagca aatttacaca ttgccactaa acgtctaaac ccttgtaatt 31140
tgtttttgtt ttactatgtg tgttatgtat ttgatttgcg ataaattttt atatttggta 31200
ctaaatttat aacacctttt atgctaacgt ttgccaacac ttagcaattt gcaagttgat 31260
taattgattc taaattattt ttgtcttcta aatacatata ctaatcaact ggaaatgtaa 31320
atatttgcta atatttctac tataggagaa ttaaagtgag tgaatatggt accacaaggt 31380
ttggagattt aattgttgca atgctgcatg gatggcatat acaccaaaca ttcaataatt 31440
cttgaggata ataatggtac cacacaagat ttgaggtgca tgaacgtcac gtggacaaaa 31500
ggtttagtaa tttttcaaga caacaatgtt accacacaca agttttgagg tgcatgcatg 31560
gatgccctgt ggaaagttta aaaatatttt ggaaatgatt tgcatggaag ccatgtgtaa 31620
aaccatgaca tccacttgga ggatgcaata atgaagaaaa ctacaaattt acatgcaact 31680
agttatgcat gtagtctata taatgaggat tttgcaatac tttcattcat acacactcac 31740
taagttttac acgattataa tttcttcata gccagtactg tttaagcttc actgtctctg 31800
aatcggcaaa ggtaaacgta tcaattattc tacaaaccct tttatttttc ttttgaatta 31860
ccgtcttcat tggttatatg ataacttgat aagtaaagct tcaataattg aatttgatct 31920
gtgttttttt ggccttaata ctaaatcctt acataagctt tgttgcttct cctcttgtga 31980
gttgagtgtt aagttgtaat aatggttcac tttcagcttt agaagaaacg cgccttccat 32040
ggctacaaag gaggcttacg ttttcccaac tctcaccgag atcaagagat ctctcccaaa 32100
ggattgcttc gaggcttctg tgcctttgtc tctctactac actgtgagat gcttggttat 32160
tgctgtggct ttgaccttcg gattgaacta cgctagagct ttgccagagg ttgagtcttt 32220
ctgggctttg gatgctgctt tgtgcactgg atatatcctc ctccagggaa ttgtgttctg 32280
gggattcttc actgttggac acgatgctgg acacggagct ttctctagat accacctctt 32340
gaacttcgtt gtgggaacct tcatgcactc tctcatcttg accccattcg agtcttggaa 32400
gttgacccac agacaccacc acaagaacac cggaaacatc gatagagatg aggtgttcta 32460
cccacagaga aaggctgatg atcacccatt gtccaggaac ttgatcttgg ctttgggagc 32520
tgcttggctt gcttatttgg tggagggatt cccaccaaga aaggtgaacc acttcaaccc 32580
attcgagcca ctttttgtga gacaagtgtc cgctgtggtt atctctttgc tcgctcactt 32640
cttcgttgct ggactctcta tctacttgtc tctccagttg ggacttaaga ccatggctat 32700
ctactactac ggaccagttt tcgtgttcgg atctatgttg gtgattacca ccttcttgca 32760
ccacaacgat gaggagactc catggtatgc tgattctgag tggacttacg tgaagggaaa 32820
cttgtcctct gtggatagat cttacggtgc tctcatcgat aacctctccc acaacatcgg 32880
aactcaccag atccaccacc tcttcccaat tatcccacac tacaagctca agaaggctac 32940
tgctgctttc caccaagctt tcccagagct tgtgagaaag tccgatgagc caatcatcaa 33000
ggctttcttc agagtgggaa ggttgtatgc taactacgga gtggttgatc aagaggctaa 33060
gctcttcact ttgaaggagg ctaaggctgc tactgaagct gctgctaaga ccaagtctac 33120
ctgattaatg aatcgacaag ctcgagtttc tccataataa tgtgtgagta gttcccagat 33180
aagggaatta gggttcctat agggtttcgc tcatgtgttg agcatataag aaacccttag 33240
tatgtatttg tatttgtaaa atacttctat caataaaatt tctaattcct aaaaccaaaa 33300
tccagtacta aaatccagat cccccgaatt aattcggcgt taattcagct acgtaggctc 33360
agctgagctt acctaaggct acgtaggctc acgtgacgtt acgtaaggct acgtagcgtc 33420
acgtgagctt acctaactct agctagcctc acgtgacctt agctaacact aggtagcgtc 33480
agcacagatg aatactagct gttgttcaca gttctagtgt ctcctcatta cgtgaattca 33540
agctacgatc actatctcaa ctcctacata aacatcagaa tgctacaaaa ctatgcacaa 33600
aaacaaaagc tacatctaat acgtgaatca attactctca tcacaagaaa gaagatttca 33660
atcaccgtcg agaaggagga ttcagttaat tgaatcaaag ttccgatcaa actcgaagac 33720
tggtgagcac gaggacgacg aagaagagtg tctcgaagat acaacaagca agaaatctac 33780
tgagtgacct cctgaagtta ttggcgcgat tgagagaatc aatccgaatt aatttcgggg 33840
aaaaagataa attagatact aagcgatggg cttgggctgg gctaagaaac aggtggcaat 33900
tgggctggag gaccccgcga ttcatagctt ccgatagccc aaaaaaaaac ggataacata 33960
tttatcgggt atttgaattt cagtgaaata agatattttc tttttgttag gaaaatttta 34020
gaaaataatg gaaattaaat agcgattatg ttacaagata cgatcagcat cgggcagtgc 34080
aaaatgctat agcttcccaa gatttgatcc ttttgggtta tctcctaatg acaattagtt 34140
taggattttg aaacttatat taatactatt atccgacaac acttgtttca gcttcttatt 34200
ttaacatttt ttgttttttt ctattcttct tcccatcagc attttctttt taaaaaattg 34260
aatactttaa ctttttaaaa atttcacaat gatcagatga tattatggaa gatctcaaga 34320
gttaaatgta tccatcttgg ggcattaaaa ccggtgtacg ggatgataaa tacagacttt 34380
atatcatatg atagctcagt aattcatatt tatcacgttg ctaaaaaaat tataaggtac 34440
tagtagtcaa caaaatcaat taaagagaaa gaaagaaacg catgtgaaga gagtttacaa 34500
ctggaaaagt aaaataaaaa ttaacgcatg ttgaatgctg acatgtcagt atgtccatga 34560
atccacgtat caagcgccat tcatcgatcg tcttcctctt tctaaatgaa aacaacttca 34620
cacatcacaa caaacaatac acacaagacc ccctctctct cgttgtctct ctgccagcga 34680
ccaaatcgaa gcttgagaag aacaagaagg ggtcaaacca tgggaaaagg atctgaggga 34740
agatctgctg ctagagagat gactgctgag gctaacggag ataagagaaa gaccatcctc 34800
attgagggag tgttgtacga tgctaccaac ttcaaacacc caggaggttc cattattaac 34860
ttcctcaccg agggagaagc tggagttgat gctacccaag cttacagaga gttccatcag 34920
agatccggaa aggctgataa gtacctcaag tccctcccaa agttggatgc ttctaaggtg 34980

```
gagtctaggt tctctgctaa ggagcaggct agaagggacg ctatgaccag ggattacgct  35040
gctttcagag aggagttggt tgctgaggga tacttcgatc catctatccc acacatgatc  35100
tacagagtgg tggagattgt ggctttgttc gctttgtctt tctggttgat gtctaaggct  35160
tctccaacct ctttggtttt gggagtggtg atgaacggaa tcgctcaagg aagatgcgga  35220
tgggttatgc acgagatggg acacggatct ttcactggag ttatctggct cgatgatagg  35280
atgtgcgagt tcttctacgg agttggatgt ggaatgtctg gacactactg gaagaaccag  35340
cactctaagc accacgctgc tccaaacaga ttggagcacg atgtggattt gaacaccttg  35400
ccactcgttg ctttcaacga gagagttgtg aggaaggtta agccaggatc tttgttggct  35460
ttgtggctca gagttcaggc ttatttgttc gctccagtgt cttgcttgtt gatcggattg  35520
ggatggacct tgtacttgca cccaagatat atgctcagga ccaagagaca catggagttt  35580
gtgtggatct tcgctagata tatcggatgg ttctccttga tgggagcttt gggatattct  35640
cctggaactt ctgtgggaat gtacctctgc tctttcggac ttggatgcat ctacatcttc  35700
ctccaattcg ctgtgtctca cacccacttg ccagttacca acccagagga tcaattgcac  35760
tggcttgagt acgctgctga tcacaccgtg aacatctcta ccaagtcttg gttggttacc  35820
tggtggatgt ctaacctcaa cttccaaatc gagcaccact tgttcccaac cgctccacaa  35880
ttcaggttca aggagatctc tccaagagtt gaggctctct tcaagagaca caacctccct  35940
tactacgatt tgccatacac ctctgctgtt tctactacct tcgctaacct ctactctgtt  36000
ggacactctg ttggagctga taccaagaag caggattgat gattaatgaa taattgattg  36060
tacatactat atttttgtt taccttgtgt tagtttaatg ttcagtgtcc tctctttatt  36120
gtggcacgtc tctttgttgt atgttgtgtc tatacaaagt tgaaataatg gaaagaaaag  36180
gaagagtgta atttgtttg ttttaagtgt ttataaatat atatatatag gtcatttaga  36240
tagttctagg tttctataaa actctctctc tggaagtaga atctgttttt gagaggatcc  36300
agttgcctac taatctcccc caaaaccctt caagcttaac cttcctcttc acaacaacag  36360
aggaaacaca tctcttgagc tctgagttct cttctttgag catgtctatc gctaaactca  36420
tctgccttat agcttccctc ttctcttcat ctctctctct caccatttcg ctgtaaaact  36480
tattctcctc cctcagcctc tctatctctt ccttcagcat ctcacaattc ccaccataat  36540
cgactgagga tgattcaccg tcatcaactt cagactcagc gttgtagtcg tcatgagtct  36600
cacaagcctt ggaccaagaa gactcatcat cgcaagttga tgatttatca tgatgcttct  36660
ctgagccgtg tttgctagct agcctcagct gacgttacgt aacgctaggt agcgtcacgt  36720
gacgttagct aacgctaggt agcgtcagct gagcttacgt aagcgcacag atgaatacta  36780
gctgttgttc acagttctag tgtctcctca ttacgtgaat tcaagctacg atcactatct  36840
caactcctac ataaacatca gaatgctaca aaactatgca caaaaacaaa agctacatct  36900
aatacgtgaa tcaattactc tcatcacaag aaagaagatt tcaatcaccg tcgagaagga  36960
ggattcagtt aattgaatca aagttccgat caaactcgaa gactggtgag cacgaggacg  37020
acgaagaaga gtgtctcgaa gatacaacaa gcaagaaatc tactgagtga cctcctgaag  37080
ttattggcgc gattgagaga atcaatccga attaatttcg gggaaaaaga taaattagat  37140
actaagcgat gggcttgggc tgggctaaga aacaggtggc aattgggctg gaggaccccg  37200
cgattcatag cttccgatag cccaaaaaaa aacggataac atatttatcg ggtatttgaa  37260
tttcagtgaa ataagatatt ttctttttgt taggaaaatt ttagaaaata atggaaatta  37320
aatagcgatt atgttacaag atacgatcag catcgggcag tgcaaaatgc tatagcttcc  37380
caagatttga tccttttggg ttatctccta atgacaatta gtttaggatt ttgaaactta  37440
tattaatact attatccgac aacacttgtt tcagcttctt attttaacat tttttgtttt  37500
tttctattct tcttcccatc agcattttct ttttaaaaaa ttgaatactt taactttta  37560
aaaatttcac aatgatcaga tgatattatg gaagatctca agagttaaat gtatccatct  37620
tggggcatta aaaccggtgt acgggatgat aaatacagac tttatatcat atgatagctc  37680
agtaattcat atttatcacg ttgctaaaaa aattataagg tactagtagt caacaaaatc  37740
aattaaagag aaagaaagaa acgcatgtga agagagttta caactggaaa agtaaaataa  37800
aaattaacgc atgttgaatg ctgacatgtc agtatgtcca tgaatccacg tatcaagcgc  37860
cattcatcga tcgtcttcct ctttctaaat gaaaacaact tcacacatca caacaaacaa  37920
tacacacaag acccccctctc tctcgttgtc tctctgccag cgaccaaatc gaagcttgag  37980
aagaacaaga aggggtcaaa ccatggcttc tacatctgct gctcaagacg ctgctcctta  38040
cgagttccct tctctcactg agatcaagag ggctcttcct tctgagtgtt tcgaggcttc  38100
tgttcctctt tctctctact acaccgctag atctcttgct cttgctggat ctctcgctgt  38160
tgctctctct tacgctagag ctttgcctct tgttcaggct aacgctcttc ttgatgctac  38220
tctctgcact ggatacgttc ttctccaggg aatcgttttc tggggattct tcaccgttgg  38280
tcacgattgt ggacacggag ctttctctag atctcacgtg ctcaacttct ctgttggaac  38340
cctcatgcac tctatcatcc ttacccccttt cgagtcttgg aagctctctc acagacacca  38400
ccacaagaac accggaaaca tcgataagga cgagatcttc taccctcaaa gagaggctga  38460
ttctcaccct gtttctagac accttgtgat gtctcttgga tctgcttggt tcgcttacct  38520
tttcgctgga ttccctccta gaaccatgaa ccacttcaac ccttgggagg ctatgtatgt  38580
tagaagagtg gctgctgtga tcatctctct cggagttctt ttcgctttcg ctggactcta  38640
ctcttacctc accttcgttc ttggattcac cactatggct atctactact tcggacctct  38700
cttcatcttc gctaccatgc ttgttgttac cactttcctc caccacaacg atgaggagac  38760
accttggtac gctgattctg agtggactta cgtgaaggga aacctctctt ctgtggacag  38820
atcttacggt gctctcatcg acaaccttag ccacaacatc ggaactcacc agatccacca  38880
cctcttccct atcatccctc actacaagct caacgatgct actgctgctt tcgctaaggc  38940
tttccctgag cttgttagga aaaacgctgc tcctatcatc ccaactttct tcaggatggc  39000
tgctatgtac gctaagtacg gagttgttga cactgatgct aagaccttca ctctcaagga  39060
```

ggctaaggct gctgctaaga ctaagtcatc ttgatgatta atgaataatt gattgtacat 39120
actatatttt ttgtttacct tgtgttagtt taatgttcag tgtcctctct ttattgtggc 39180
acgtctcttt gttgtatgtt gtgtctatac aaagttgaaa taatggaaag aaaaggaaga 39240
gtgtaatttg ttttgtttta agtgtttata aatatatata tataggtcat ttagatagtt 39300
ctaggtttct ataaaactct ctctctggaa gtagaatctg tttttgagag gatccagttg 39360
cctactaatc tcccccaaaa cccttcaagc ttaaccttcc tcttcacaac aacagaggaa 39420
acacatctct tgagctctga gttctcttct ttgagcatgt ctatcgctaa actcatctgc 39480
cttatagctt ccctcttctc ttcatctctc tctctcacca tttcgctgta aaacttattc 39540
tcctccctca gcctctctat ctcttccttc agcatctcac aattcccacc ataatcgact 39600
gaggatgatt caccgtcatc aacttcagac tcagcgttgt agtcgtcatg agtctcacaa 39660
gccttggacc aagaagactc atcatcgcaa gttgatgatt tatcatgatg cttctctgag 39720
ccgtgtttgc tagctagcct cagctgacgt tacgtaacgc taggtagcgt cacgtgacgt 39780
tagctaacgc taggtagcgt cagctgagct tacgtaagcg cttaattaaa gtactgatat 39840
cggtaccaaa tcgaatccaa aaattacgga tatgaatata ggcatatccg tatccgaatt 39900
atccgtttga cagctagcaa cgattgtaca attgcttctt taaaaaagga agaaagaaag 39960
aaagaaaaga atcaacatca gcgttaacaa acggccccgt tacggcccaa acggtcatat 40020
agagtaacgg cgttaagcgt tgaaagactc ctatcgaaat acgtaaccgc aaacgtgtca 40080
tagtcagatc ccctcttcct tcaccgcctc aaacacaaaa ataatcttct acagcctata 40140
tatacaaccc ccccttctat ctctcctttc tcacaattca tcatctttct ttctctaccc 40200
ccaattttaa gaaatcctct cttctcctct tcattttcaa ggtaaatctc tctctctctc 40260
tctctctctg ttattccttg ttttaattag gtatgtatta ttgctagttt gttaatctgc 40320
ttatcttatg tatgccttat gtgaatatct ttatcttgtt catctcatcc gtttagaagc 40380
tataaatttg ttgatttgac tgtgtatcta cacgtggtta tgtttatatc taatcagata 40440
tgaatttctt catattgttg cgtttgtgtg taccaatccg aaatcgttga ttttttttcat 40500
ttaatcgtgt agctaattgt acgtatacat atggatctac gtatcaattg ttcatctgtt 40560
tgtgtttgta tgtatacaga tctgaaaaca tcacttctct catctgattg tgttgttaca 40620
tacatagata tagatctgtt atatcatttt ttttattaat tgtgtatata tatatgtgca 40680
tagatctgga ttacatgatt gtgattattt acatgatttt gttatttacg tatgtatata 40740
tgtagatctg gactttttgg agttgttgac ttgattgtat ttgtgtgtgt atatgtgtgt 40800
tctgatcttg atatgttatg tatgtgcagc tgaaccatgg cggcggcaac aacaacaaca 40860
acaacatctt cttcgatctc cttctccacc aaaccatctc cttcctcctc caaatcacca 40920
ttaccaatct ccagattctc cctcccattc tccctaaacc ccaacaaatc atcctcctcc 40980
tcccgccgcc gcggtatcaa atccagctct ccctcctcca tctccgccgt gctcaacaca 41040
accaccaatg tcacaaccac tccctctcca accaaaccta ccaaacccga aacattcatc 41100
tcccgattcg ctccagatca accccgcaaa ggcgctgata tcctcgtcga ggctttagaa 41160
cgtcaaggcg tagaaaccgt attcgcttac cctggaggta catcaatgga gattcaccaa 41220
gccttaaccc gctcttcctc aatccgtaac gtccttcctc gtcacgaaca aggaggtgta 41280
ttcgcagcag aaggatacgc tcgatcctca ggtaaaccag gtatctgtat agccacttca 41340
ggtcccggag ctacaaatct cgttagcgga ttagccgatg cgttgttaga tagtgttcct 41400
cttgtagcaa tcacaggaca agtccctcgt cgtatgattg gtacagatgc gtttcaagag 41460
actccgattg ttgaggtaac gcgttcgatt acgaagcata actatcttgt gatggatgtt 41520
gaagatatcc caaggattat tgaagaggct ttctttttag ctacttctgg tagacctgga 41580
cctgttttgg ttgatgttcc taaagatatt caacaacagc ttgcgattcc taattgggaa 41640
caggctatga gattacctgg ttatatgtct aggatgccta aacctccgga agattctcat 41700
ttggagcaga ttgttaggtt gatttctgag tctaagaagc ctgtgttgta tgttggtggt 41760
ggttgtctta attctagcga tgaattgggt aggtttgttg agcttacggg catccctgtt 41820
gcgagtacgt tgatggggct gggatcttat ccttgtgatg atgagttgtc gttacatatg 41880
cttggaatgc atgggactgt gtatgcaaat tacgctgtgg agcatagtga tttgttgttg 41940
gcgtttgggg taaggtttga tgatcgtgtc acgggtaaac ttgaggcttt tgctagtagg 42000
gctaagattg ttcatattga tattgactcg gctgagattg ggaagaataa gactcctcat 42060
gtgtctgtgt gtggtgatgt taagctggct ttgcaaggga tgaataaggt tcttgagaac 42120
cgagcggagg agcttaaact tgattttgga gtttggagga atgagttgaa cgtacagaaa 42180
cagaagtttc cgttgagctt taagacgttt ggggaagcta ttcctccaca gtatgcgatt 42240
aaggtccttg atgagttgac tgatggaaaa gccataataa gtactggtgt cgggcaacat 42300
caaatgtggg cggcgcagtt ctacaattac aagaaaccaa ggcagtggct atcatcagga 42360
ggccttggag ctatgggatt tggacttcct gctgcgattg gagcgtctgt tgctaaccct 42420
gatgcgatag ttgtggatat tgacggagat ggaagtttta taatgaatgt gcaagagcta 42480
gccactattc gtgtagagaa tcttccagtg aaggtacttt tattaaacaa ccagcatctt 42540
ggcatggtta tgcaatggga agatcggttc tacaaagcta accgagctca cacatttctc 42600
ggggacccgg ctcaggagga cgagatattc ccgaacatgt tgctgtttgc agcagcttgc 42660
gggattccag cggcgagggt gacaaagaaa gcagatctcc gagaagctat tcagacaatg 42720
ctggatacac caggacctta cctgttggat gtgatttgtc cgcaccaaga acatgtgttg 42780
ccgatgatcc cgaatggtgg cactttcaac gatgtcataa cggaaggaga tggccggatt 42840
aaatactgag agatgaaacc ggtgattatc agaacctttt atggtctttg tatgcatatg 42900
gtaaaaaaac ttagtttgca atttcctgtt tgttttggta atttgagttt cttttagttg 42960
ttgatctgcc tgctttttgg tttacgtcag actactactg ctgttgttgt ttggtttcct 43020
ttctttcatt ttataaataa ataatccggt tcggtttact ccttgtgact ggctcagttt 43080
ggttattgcg aaatgcgaat ggtaaattga gtaattgaaa ttcgttatta gggttctaag 43140

```
ctgttttaac agtcactggg ttaatatctc tcgaatcttg catggaaaat gctcttacca  43200
ttggttttta attgaaatgt gctcatatgg gccgtggttt ccaaattaaa taaaactacg  43260
atgtcatcga gaagtaaaat caactgtgtc cacattatca gttttgtgta tacgatgaaa  43320
tagggtaatt caaaatctag cttgatatgc cttttggttc attttaacct tctgtaaaca  43380
ttttttcaga ttttgaacaa gtaaatccaa aaaaaaaaaa aaaaatctca actcaacact  43440
aaattatttt aatgtataaa agatgcttaa aacatttggc ttaaaagaaa gaagctaaaa  43500
acatagagaa ctcttgtaaa ttgaagtatg aaaatatact gaattgggta ttatatgaat  43560
ttttctgatt taggattcac atgatccaaa aaggaaatcc agaagcacta atcagacatt  43620
ggaagtagga ttaatcagtg atcagtaact attaaattca attaaccgcg gacatctaca  43680
tttttgaatt gaaaaaaaat tggtaattac tctttctttt tctccatatt gaccatcata  43740
ctcattgctg atccatgtag atttcccgga catgaagcca tttacaattg aatatatcct  43800
gccgccgctg ccgctttgca cccggtggag cttgcatgtt ggtttctacg cagaactgag  43860
ccggttaggc agataatttc cattgagaac tgagccatgt gcaccttccc cccaacacgg  43920
tgagcgacgg ggcaacggag tgatccacat gggactttta aacatcatcc gtcggatggc  43980
gttgcgagag aagcagtcga tccgtgagat cagtcgacca attctcatgt ttgacagctt  44040
atcatcgaat ttctgccatt catccgctta ttatcactta ttcaggcgta gcaaccaggc  44100
gtttaagggc accaataact gccttaaaaa aattacgccc cgccctgcca ctcatcgcag  44160
tactgttgta attcattaag cattctgccg acatggaagc catcacaaac ggcatgatga  44220
acctgaatcg ccagcggcat cagcaccttg tcgccttgcg tataatattt gcccatggtg  44280
aaaacggggg cgaagaagtt gtccatattg gccacgttta aatcaaaact ggtgaaactc  44340
acccagggat tggctgagac gaaaaacata ttctcaataa accctttagg gaaataggcc  44400
aggttttcac cgtaacacgc cacatcttgc gaatatatgt gtagaaactg ccggaaatcg  44460
tcgtggtatt cactccagag cgatgaaaac gtttcagttt gctcatggaa aacggtgtaa  44520
caagggtgaa cactatccca tatcaccagc tcaccgtctt tcattgccat acggaattcc  44580
ggatgagcat tcatcaggcg ggcaagaatg tgaataaagg ccggataaaa cttgtgctta  44640
tttttcttta cggtctttaa aaaggccgta atatccagga cctgcagggg gggggggg cg  44700
ctgaggtctg cctcgtgaag aaggtgttgc tgactcatac caggcctgaa tcgccccatc  44760
atccagccag aaagtgaggg agccacggtt gatgagagct ttgttgtagg tggaccagtt  44820
ggtgattttg aacttttgct ttgccacgga acggtctgcg ttgtcgggaa gatgcgtgat  44880
ctgatccttc aactcagcaa aagttcgatt tattcaacaa agccgccgtc ccgtcaagtc  44940
agcgtaatgc tctgccagtg ttacaaccaa ttaaccaatt ctgattagaa aaactcatcg  45000
agcatcaaat gaaactgcaa tttattcata tcaggattat caataccata tttttgaaaa  45060
agccgtttct gtaatgaagg agaaaactca ccgaggcagt tccataggat ggcaagatcc  45120
tggtatcggt ctgcgattcc gactcgtcca acatcaatac aacctattaa tttcccctcg  45180
tcaaaaataa ggttatcaag tgagaaatca ccatgagtga cgactgaatc cggtgagaat  45240
ggcaaaagct tatgcatttc tttccagact tgttcaacag gccagccatt acgctcgtca  45300
tcaaaatcac tcgcatcaac caaaccgtta ttcattcgtg attgcgcctg agcgagacga  45360
aatacgcgat cgctgttaaa aggacaatta caaacaggaa tcgaatgcaa ccggcgcagg  45420
aacactgcca gcgcatcaac aatattttca cctgaatcag gatattcttc taatacctgg  45480
aatgctgttt tcccggggat cgcagtggtg agtaaccatg catcatcagg agtacggata  45540
aaatgcttga tggtcggaag aggcataaat tccgtcagcc agtttagtct gaccatctca  45600
tctgtaacat cattggcaac gctacctttg ccatgtttca gaaacaactc tggcgcatcg  45660
ggcttcccat acaatcgata gattgtcgca cctgattgcc cgacattatc gcgagcccat  45720
ttatacccat ataaatcagc atccatgttg gaatttaatc gcggcctcga gcaagacgtt  45780
tcccgttgaa tatggctcat aacacccctt gtattactgt ttatgtaagc agacagtttt  45840
attgttcatg atgatatatt tttatcttgt gcaatgtaac atcagagatt ttgagacaca  45900
acgtggcttt cccccccccc cctgcaggtc ctgaacggtc tggttatagg tacattgagc  45960
aactgactga aatgcctcaa aatgttcttt acgatgccat tgggatatat caacggtggt  46020
atatccagtg atttttttct ccattttagc ttccttagct cctgaaaatc tcgataactc  46080
aaaaaatacg cccggtagtg atcttatttc attatggtga aagttggaac ctcttacgtg  46140
ccgatcaacg tctcattttc gccaaaagtt ggcccagggc ttcccggtat caacagggac  46200
accaggattt atttattctg cgaagtgatc ttccgtcaca ggtatttatt cgcgataagc  46260
tcatggagcg gcgtaaccgt cgcacaggaa ggacagagaa agcgcggatc tgggaagtga  46320
cggacagaac ggtcaggacc tggattgggg aggcggttgc cgccgctgct gctgacggtg  46380
tgacgttctc tgttccggtc acaccacata cgttccgcca ttcctatgcg atgcacatgc  46440
tgtatgccgg tataccgctg aaagttctgc aaagcctgat gggacataag tccatcagtt  46500
caacggaagt ctacacgaag gtttttgcgc tggatgtggc tgcccggcac cgggtgcagt  46560
ttgcgatgcc ggagtctgat gcggttgcga tgctgaaaca attatcctga gaataaatgc  46620
cttggccttt atatggaaat gtggaactga gtggatatgc tgtttttgtc tgttaaacag  46680
agaagctggc tgttatccac tgagaagcga acgaaacagt cgggaaaatc tcccattatc  46740
gtagagatcc gcattattaa tctcaggagc ctgtgtagcg tttataggaa gtagtgttct  46800
gtcatgatgc ctgcaagcgg taacgaaaac gatttgaata tgccttcagg aacaatagaa  46860
atcttcgtgc ggtgttacgt tgaagtggag cggattatgt cagcaatgga cagaacaacc  46920
taatgaacac agaaccatga tgtggtctgt ccttttacag ccagtagtgc tcgccgcagt  46980
cgagcgacag ggcgaagccc tcgagtgagc gaggaagcac cagggaacag cacttatata  47040
ttctgcttac acacgatgcc tgaaaaaact tcccttgggg ttatccactt atccacgggg  47100
atatttttat aattattttt tttatagttt ttagatcttc tttttttagag cgccttgtag  47160
gcctttatcc atgctggttc tagagaaggt gttgtgacaa attgcccttt cagtgtgaca  47220
```

aatcaccctc aaatgacagt cctgtctgtg acaaattgcc cttaaccctg tgacaaattg 47280
ccctcagaag aagctgtttt ttcacaaagt tatccctgct tattgactct tttttattta 47340
gtgtgacaat ctaaaaactt gtcacacttc acatggatct gtcatggcgg aaacagcggt 47400
tatcaatcac aagaaacgta aaaatagccc gcgaatcgtc cagtcaaacg acctcactga 47460
ggcggcatat agtctctccc gggatcaaaa acgtatgctg tatctgttcg ttgaccagat 47520
cagaaaatct gatggcaccc tacaggaaca tgacggtatc tgcgagatcc atgttgctaa 47580
atatgctgaa atattcggat tgacctctgc ggaagccagt aaggatatac ggcaggcatt 47640
gaagagtttc gcggggaagg aagtggtttt ttatcgccct gaagaggatg ccggcgatga 47700
aaaaggctat gaatcttttc cttggtttat caaacgtgcg cacagtccat ccagagggct 47760
ttacagtgta catatcaacc catatctcat tcccttcttt atcgggttac agaaccggtt 47820
tacgcagttt cggcttagtg aaacaaaaga aatcaccaat ccgtatgcca tgcgtttata 47880
cgaatccctg tgtcagtatc gtaagccgga tggctcaggc atcgtctctc tgaaaatcga 47940
ctggatcata gagcgttacc agctgcctca aagttaccag cgtatgcctg acttccgccg 48000
ccgcttcctg caggtctgtg ttaatgagat caacagcaga actccaatgc gcctctcata 48060
cattgagaaa aagaaaggcc gccagacgac tcatatcgta ttttccttcc gcgatatcac 48120
ttccatgacg acaggatagt ctgagggtta tctgtcacag atttgagggt ggttcgtcac 48180
atttgttctg acctactgag ggtaatttgt cacagttttg ctgtttcctt cagcctgcat 48240
ggattttctc atacttttg aactgtaatt tttaaggaag ccaaatttga gggcagtttg 48300
tcacagttga tttccttctc tttcccttcg tcatgtgacc tgatatcggg ggttagttcg 48360
tcatcattga tgagggttga ttatcacagt ttattactct gaattggcta tccgcgtgtg 48420
tacctctacc tggagttttt cccacggtgg atatttcttc ttgcgctgag cgtaagagct 48480
atctgacaga acagttcttc tttgcttcct cgccagttcg ctcgctatgc tcggttacac 48540
ggctgcggcg agcgctagtg ataataagtg actgaggtat gtgctcttct tatctccttt 48600
tgtagtgttg ctcttatttt aaacaacttt gcggtttttt gatgactttg cgattttgtt 48660
gttgctttgc agtaaattgc aagatttaat aaaaaaacgc aaagcaatga ttaaaggatg 48720
ttcagaatga aactcatgga aacacttaac cagtgcataa acgctggtca tgaaatgacg 48780
aaggctatcg ccattgcaca gtttaatgat gacagcccgg aagcgaggaa aataacccgg 48840
cgctggagaa taggtgaagc agcggattta gttggggttt cttctcaggc tatcagagat 48900
gccgagaaag cagggcgact accgcacccg gatatggaaa ttcgaggacg ggttgagcaa 48960
cgtgttggtt atacaattga acaaattaat catatgcgtg atgtgtttgg tacgcgattg 49020
cgacgtgctg aagacgtatt tccaccggtg atcggggttg ctgcccataa aggtggcgtt 49080
tacaaaacct cagtttctgt tcatcttgct caggatctgg ctctgaaggg gctacgtgtt 49140
ttgctcgtgg aaggtaacga cccccaggga acagcctcaa tgtatcacgg atgggtacca 49200
gatcttcata ttcatgcaga agacactctc ctgcctttct atcttgggga aaaggacgat 49260
gtcacttatg caataaagcc cacttgctgg ccggggcttg acattattcc ttcctgtctg 49320
gctctgcacc gtattgaaac tgagttaatg ggcaaatttg atgaaggtaa actgcccacc 49380
gatccacacc tgatgctccg actggccatt gaaactgttg ctcatgacta tgatgtcata 49440
gttattgaca gcgcgcctaa cctgggtatc ggcacgatta atgtcgtatg tgctgctgat 49500
gtgctgattg ttcccacgcc tgctgagttg tttgactaca cctccgcact gcagtttttc 49560
gatatgcttc gtgatctgct caagaacgtt gatcttaaag ggttcgagcc tgatgtacgt 49620
attttgctta ccaaatacag caatagtaat ggctctcagt ccccgtggat ggaggagcaa 49680
attcgggatg cctggggaag catggttcta aaaaatgttg tacgtgaaac ggatgaagtt 49740
ggtaaaggtc agatccggat gagaactgtt tttgaacagg ccattgatca acgctcttca 49800
actggtgcct ggagaaatgc tctttctatt tgggaacctg tctgcaatga aattttcgat 49860
cgtctgatta aaccacgctg ggagattaga taatgaagcg tgcgcctgtt attccaaaac 49920
atacgctcaa tactcaaccg gttgaagata cttcgttatc gacaccagct gccccgatgg 49980
tggattcgtt aattgcgcgc gtaggagtaa tggctcgcgg taatgccatt actttgcctg 50040
tatgtggtcg ggatgtgaag tttactcttg aagtgctccg ggtgatagt gttgagaaga 50100
cctctcgggt atggtcaggt aatgaacgtg accaggagct gcttactgag gacgcactgg 50160
atgatctcat cccttctttt ctactgactg gtcaacagac accggcgttc ggtcgaagag 50220
tatctggtgt catagaaatt gccgatggga gtcgccgtcg taaagctgct gcacttaccg 50280
aaagtgatta tcgtgttctg gttggcgagc tggatgatga gcagatggct gcattatcca 50340
gattgggtaa cgattatcgc ccaacaagtg cttatgaacg tggtcagcgt tatgcaagcc 50400
gattgcagaa tgaatttgct ggaaatattt ctgcgctggc tgatgcggaa aatatttcac 50460
gtaagattat tacccgctgt atcaacaccg ccaaattgcc taaatcagtt gttgctcttt 50520
tttctcaccc cggtgaacta tctgcccggt caggtgatgc acttcaaaaa gcctttacag 50580
ataaagagga attacttaag cagcaggcat ctaaccttca tgagcagaaa aaagctgggg 50640
tgatatttga agctgaagaa gttatcactc ttttaacttc tgtgcttaaa acgtcatctg 50700
catcaagaac tagtttaagc tcacgacatc agtttgctcc tggagcgaca gtattgtata 50760
agggcgataa aatggtgctt aacctggaca ggtctcgtgt tccaactgag tgtatagaga 50820
aaattgaggc cattcttaag gaacttgaaa agccagcacc ctgatgcgac cacgttttag 50880
tctacgttta tctgtcttta cttaatgtcc tttgttacag gccagaaagc ataactggcc 50940
tgaatattct ctctgggccc actgttccac ttgtatcgtc ggtctgataa tcagactggg 51000
accacggtcc cactcgtatc gtcggtctga ttattagtct gggaccacgg tcccactcgt 51060
atcgtcggtc tgattattag tctgggacca cggtcccact cgtatcgtcg gtctgataat 51120
cagactggga ccacggtccc actcgtatcg tcggtctgat tattagtctg ggaccatggt 51180
cccactcgta tcgtcggtct gattattagt ctgggaccac ggtcccactc gtatcgtcgg 51240
tctgattatt agtctggaac cacggtccca ctcgtatcgt cggtctgatt attagtctgg 51300

gaccacggtc ccactcgtat cgtcggtctg attattagtc tgggaccacg atcccactcg 51360
tgttgtcggt ctgattatcg gtctgggacc acggtcccac ttgtattgtc gatcagacta 51420
tcagcgtgag actacgattc catcaatgcc tgtcaagggc aagtattgac atgtcgtcgt 51480
aacctgtaga acggagtaac ctcggtgtgc ggttgtatgc ctgctgtgga ttgctgctgt 51540
gtcctgctta tccacaacat tttgcgcacg gttatgtgga caaaatacct ggttacccag 51600
gccgtgccgg cacgtttcct acaaggtaga atccgcctga gtcgcaaggg tgacttcgcc 51660
tatattggac gacggcgcgc agagggcgac ctctttttgg gttacgattg taggattatc 51720
actaaaacaa tacatgaaca tattcaaatg gcaatctctc taaggcattg gaaataaata 51780
caaataacag ttgggtggag tttttcgacc tgagggcgtt aactcttcaa ggacaacaag 51840
accgtggacg tcgagcggct ctccgacaag catgtcgccc gcctggtcaa gcagaccgca 51900
ctcgccgccg gcgcttcgat accgttcgta ttggtccggc gaaactgtga gtatccgcat 51960
cgtaatctcc gcatgaacag gtcatgcgaa cagaaatcat ctcacggtgc gtttgcctac 52020
gtgcagattt gcacctcagg tgattctacc gagtcggtgt tccaaggcgc gaaatgcgag 52080
cgggtgaggc cgaccagacg ccgacaaggt tgtgcagatc tgcacttggt gccacgtcgc 52140
acagaagaag ggaatcggtc taactcacag atagcatttg aagaatcggg atttagtgtg 52200
atttcgattg aaacgcgcgt aaccgttcat taaccaaaaa cgtcttgcaa cctcacccgc 52260
attaggtaat cgtcacggat aaatggcaat acgcgccaat taaccgtgac aagagataac 52320
accgtgagca aagccgctgc catatcccga aatgatcgcc cgtcggtaga tgttaccatt 52380
ggtgagcatg ctgagcagct cagctctcag cttcaagcga tgagcgaggc tttgtttcct 52440
ccgacgtcgc acaagagctt gcgcaaattc acctcgggtg aagccgcacg cttgatgaaa 52500
atatctgact caactcttcg aaagatgaca ctggctggcg aagggccgca acctgaactc 52560
gccagcaacg gacggcgctt ttacaccctc ggtcagataa acgaaatccg gcagatgctt 52620
gccggctcga ctcgaggacg tgaaagcatt gattttgtgc ctcatcgccg aggttctgag 52680
catttgcaag tcgttgctgt aaccaacttc aaaggtggct ctgggaagac gacgacgtcc 52740
gctcatcttg cacagtatct ggcgttgcaa ggttacaggg ttctcgcagt cgatctcgat 52800
ccgcaggcta gtctttcagc actcctcggc gttctgccag aaactgatgt cggtgcaaac 52860
gaaacgctct atgcggctat tcggtacgac gacacacgtc gtccgttgcg agatgtgatc 52920
cgaccgacgt attttgatgg tcttcacctt gttcctggaa atctcgagct tatggagttc 52980
gagcatacca ccccgaaagc attgactgac aaaggtacgc gcgacggatt gttcttcact 53040
cgcgtggccc aagcctttga tgaggtcgcc gacgattacg atgtcgtggt catcgactgc 53100
cctcctcagc ttgggttttt gactctcagc gggttgtgtg ctgcaacatc aatggtaatc 53160
accgtacatc ctcagatgct ggatatcgct tccatgagcc agtttctcct catgacacgc 53220
gaccttctgg gtgtcgtgaa agaggcgggg ggcaatctcc agtacgattt catacgctat 53280
ctcttgacgc gctatgagcc ccaggacgcg ccgcagacga aagtgacggc actgctgcgc 53340
aacatgttcg aggatcacgt ccttacaaat cctatggtca agtcggcagc ggtatctgat 53400
gccggtttaa ccaagcagac gctctatgag atagggcgag agaaccttac gcgatcgaca 53460
tacgaccggg cgatggaatc tttagatgcg gtgaattcgg agatcgaggc tttgatcaag 53520
atggcgtggg ggcgggtcta atgaaaggct ttgcgttcct cacagatctg ttgggagctc 53580
ccaacagaca ggtgttgatt cgccccctgg acatggggca ctggagaagc cggggtaatt 53640
tgagacgacg acgcacgccc atcgctaatt ggccagggtg cagttgtctt gtcttgttgg 53700
gagctcccaa ccaagcgcat ttgcaatcaa aaatgcgacg ccacgacgcc aaacccaaga 53760
ggccgatatc atgagccgca aagacgcaat cgatactttg ttcctcaaga agcaacctgc 53820
gaccgataga gcagcagtcg acaagtcgac cgctcgtgtt cgtaccggag cgatttcggc 53880
catgggttcg tctttgcaag agatggctga gggcgcaaag gctgcagctc ggctgcagga 53940
tcaactggct acaggcgaag ccgtcgtgtc cctggatcca tccatgatcg acgggtcgcc 54000
gatcgcggat cggctgccct cagacgtgga tccgaaattc gagcagcttg aggcgagcat 54060
ttcgcaggag gggcagcagg tgccggttct tgtcagaccg caccctgagg ctgccggtcg 54120
atatcagatc gtatatggaa ggcggcggct gcgcgcggca gtaaatctgc ggagagaggt 54180
ttctgccatt gttcgaaatc tcacggactg tgaactggtc gtggcccagg gccgcgaaaa 54240
tcttaaccgc gctgacctct cgttcattga gaaggctctc ttcgccctgc gcctcgaaga 54300
tgcgggtttt gatagagcca ccatcattgc cgcgctatcc actgacaagg ccgacctcag 54360
ccgctacata actgtagcaa ggggcatacc gctgaacctc gccacacaaa tcggcccagc 54420
gtcgaaagcg ggtcgatcgc gttgggtcgt acttgccgag gggcttggga agcctaaggc 54480
aacggacgca atcgaagcga tgcttgggtc agagcagttc aagcaatctg atagcgatac 54540
ccgctttaac ctcattttca acgccgtttc aaggccacct gcgaagactc caaaaaaggt 54600
aagggcctgg agcacgccaa aggggaaaaa ggcagcgacg atccgacaag aaactggacg 54660
aacggcgctg gttttcgacg agagactggt gccaactttt ggcgaatatg tcgctgacca 54720
gttggacagt ctgtacgccc agttcattga aaccaacgga ggaggcaagc tcgaccaata 54780
gtcagggttt catccaattt aaagctccgc tcgactgaga tggactggct ctcaccgcaa 54840
aagaaaaagg cccccgaaac ggcgttccgg aagaccttct ctgtagtctc gcagctaaga 54900
gaatcgcatt tccaggaatc gtagtcaagg gtcccgtaag ggaaagcgtc atttcgacgg 54960
gcggatttca attgcctaac aaaaggtaaa aggaaatgca gacgcatatc tcaacgacgt 55020
cctttgggcg gcggccgatg acactcggcc atattgcaag ccagatggca gcaaaagcgg 55080
tcgcatcaga cactgtcgcc cacaaatggc aggtcttcca gcacatccgt gaatcccggg 55140
gactgatcgg agccacggac cgctcactct cgatcctgaa cgcgctgttg acgttttacc 55200
cggagaccgc cttgactggt ggtgccgaac tggtcgtatg gccttctaac gaacagctga 55260
tggctcgcgc caacggcatg cccgccacga cactgcgccg gcatcttgcc atactggttg 55320
attgcgggct catcattcgc cgcgacagcc ccaatggcaa gcggttcgcc cgcaagggaa 55380

gggg agggga gattgagcag gcctatgggt tcgatctgtc gccgatcgtc gcgcgggccg 55440
aggagttccg agatctggcc cagacagtgc aagctgaaaa aaaggccttc cgggtggcca 55500
aggagcgctt gactcttctt cgtcgtgaca ttgtcaaaat gatcgaaact ggcgtcgaag 55560
agagcgttcc tggaaactgg ggaagagtta cccagaccta tcaggggatc atcggccgcc 55620
tgccacgctc ggcacctcgg cagcttgtcg agagtattgg gcaagagctt caggaactct 55680
gcatcgagat ccgtgacgta ttggaatctt tcacaaaaac gatgaatctg gacgccaatg 55740
agtcccatat cggtcgccac aaacagaatt caaatccaga ctctaaattt gaatctgaat 55800
acagctctgg aaaaaaagat gaagcgggcg gcagcgttgc ggaaaccgac aatgtacgga 55860
gcttgccgaa acgcgagctg cctttgggaa tcgtgctgga tgcctgcccc gaaatgcggg 55920
aattggccca gggaggtcca attcggcatt ggcgcgactt gctggcggcg gctgagcttg 55980
cccggccgat gctggggatt agtccgagcg cctggcggga ggcccgcgaa accatggcg 56040
atcaacacgc ggcgatcacg ctggcttcga tctatcagcg ggccggtcag atcaataacg 56100
ctgggggcta tctgcgcagc ctgaccgacc gggccaagga tgggaagttt tcgacctggc 56160
cgatggtcat ggcgttgctc cgggcaaagc tggacgagca gaagaatgca gttggcgctg 56220
gaaagccgcg aactgctgag gaggtcgagg atgacagccg cctccacgta tcggaatcgc 56280
tgctcaaaaa cctgcgaaag ccgagatctt ggtgatcctc tcgctattca gccgcggcga 56340
tgtcgacgtc ggtgatcaac ccggaacgtc gggcgcggtc gatcaggttc ttgacggacg 56400
agggcgccca tttggatcca ccgcgcggcg tgcgctcgtg cagtctttca agctggccgg 56460
cgatctcgcg gagcttcagg tctgggttcg aagaatggat gccggccaca agcgtcatca 56520
ggcgatcttc gggaagacgg ggaggagatt ttttcaggag cgctgcatcc accaggcgtt 56580
ccgtcaccat ccacttcacg gctcggcgaa gacgttctgg cgtccagtcg aggccccgct 56640
gcttgagcat tcgggcgatg tcgtcccatg tgtgatccgg tcgcatgcga cgaacggtag 56700
gaagccattg gttcgcggac gcctgaatcc tatcgccata tgccgctttc tgggccgcgg 56760
tcatccttgc cagcgcctcc gggcgctttt cccggatgcc cgggttgccg gaaagcttcc 56820
ctaggcacaa acgttgactc ttggatcgag ctggcagaca aagcaataac ccacacagag 56880
gacgattaat ggctgacgaa gagatccaga atccgccgga cggtactgct gctgccgaag 56940
ttgagccggc tgctcctaga ggtagaagag caaagaaagc accagccgaa acagcccgca 57000
cgggatcgtt caaatccgtg aagccgaaaa cccgcggcct cagcaaccga gaaaaactgg 57060
agaagatcgg tcaaatcgaa gctcaggtcg ctggcggcgc aaccttgaag gacgccgtta 57120
agatcgtggg tatttccgtt cagacctatt atcaatggaa gagagctgcg gttcaacctg 57180
tctcacagaa tccggccgtg tctgtttcag ttgacgatga actcggcgag ttcatccaac 57240
tcgaggagga aaatcggcgg ctcagaaagc ttcacgctgc cgcaagcact cagggcgcaa 57300
gggctgctaa aggaagcgga acacgtagaa agccagtccg cagaaacggt gctgaccccg 57360
gatgaatgtc agctactggg ctatctggac aagggaaaac gcaagcgcaa agagaaagca 57420
ggtagcttgc agtgggctta catggcgata gctagactgg gcggttttat ggacagcaag 57480
cgaaccggaa ttgccagctg ggcgccctc tgggaaggtt gggaagccct gcaaagtaaa 57540
ctggatggct ttcttgccgc caaggatctg atggcgcagg ggatcaagat ctgatcaaga 57600
gacaggggcc ggcccacgct gtcgtccaat ctcccaagac acgccgccac cgcgcaccgt 57660
cgcggcgagc tgctccccaa gccgctgttc gatgggcttc caccgcacga ggctggaccc 57720
cttggcgtca tcaagcatcc catttcgccc gctggcgagc atgacggggc gccggtagac 57780
gccggcaacg cgctggccgt cggccacggg gcgatgctcc aggccggtat cggcggcaat 57840
gtccttcgcg gcctgcgcca gttcccgagc ccgctgctgc ccagcagatt ccggtgagga 57900
tcacgcgctg cccgcgccgc tcggccagtc cctgttcggc caggaagtcc gcgcgctgct 57960
gtatcgccta cttggcctca ctgctaaagc ccaggtcgcc caagcccgag ccaccgtcga 58020
tcaactgctg gtcaagccag gtggcaccga tcacgcgggc ctgccgctcg atgggcaggt 58080
gcgatttcag ctccaccgtc acgccaccaa gacgctgggc gtcatagcgg cggccctgct 58140
cgggcagatc gtccggcacc ttccatagtc cctcggccac gcacaccacg atgccggcct 58200
ggtgcagggc ttcgaggcgg cgggtgtggc ccgcaacgac ttccagcgga tcacgcccga 58260
cacggcctga cctagctcga cgaccaggtg agatcggtga ccgcgctagt caagcaaccg 58320
gcgtgccatg gcgtttacgg ccagatcaat cgcagcgccc tcgccctcgc cgtcgccgtc 58380
gccgatgaac caggctgccg acaagcccgt ccatgcaatg atccagcgaa gaagccgttc 58440
gggctcaaac ccggtcgtcg cgaccacaat gctgagtcga gcctccagcc tgcccggcag 58500
gatcgcaagc gggcgaccgg ggtcgctgag atcgggattc gtgaagatgt tggcatagtc 58560
gaaggtgcgc tcgccgagca gtccgtgcgg gtcgatggcc agccagccgc ggtcgccgaa 58620
gtcgagcacg ttctcgtggt gcaggtcgcc gtggagcggg cacacctcgc gcggcgccgc 58680
cagaagttgg cgcgctacgc tggcggcggg cgcaagtgcc gcgtgctcag cggccaaccg 58740
gaaaagcggc tggaaccatt cctgtagcgg atggagatcg ggcggcggtc cggaccgcgg 58800
cgcgtgcaga cgagcggcgg tgtcgcagag gatcgtggca tcaccgaacc gcgccgtgcg 58860
cgggtcgtcg gtgagccaga gtttcagcag gccgcccagg cggcccaggt cgccattgat 58920
gcgggccagc tcgcggacgt gctcatagtc cacgacgccc gtgattttgt agccctggcc 58980
gacggccagc aggtaggccg acaggctcat gccggccgcc gccgcctttt cctcaatcgc 59040
tcttcgttcg tctggaaggc agtacacctt gataggtggg ctgcccttcc tggttggctt 59100
ggtttcatca gccatccgct tgccctcatc tgttacgccg gcggtagccg gccagcctcg 59160
cagagcagga ttcccgttga gcaccgccag gtgcgaataa gggacagtga agaaggaaca 59220
cccgctcgcg ggtgggccta cttcacctat cctgcccggc tgacgccgtt ggatacacca 59280
aggaaagtct acacgaaccc tttggcaaaa tcctgtatat cgtgcgaaaa aggatggata 59340
taccgaaaaa atcgctataa tgaccccgaa gcagggttat gcagcggaaa agcgctgctt 59400
ccctgctgtt ttgtggaata tctaccgact ggaaacaggc aaatgcagga aattactgaa 59460

ctgaggggac aggcgagaga cgatgccaaa gagctacacc gacgagctgg ccgagtgggt 59520
tgaatcccgc gcggccaaga agcgccggcg tgatgaggct gcggttgcgt tcctggcggt 59580
gagggcggat gtcgaggcgg cgttagcgtc cggctatgcg ctcgtcacca tttgggagca 59640
catgcgggaa acggggaagg tcaagttctc ctacgagacg ttccgctcgc acgccaggcg 59700
gcacatcaag gccaagcccg ccgatgtgcc cgcaccgcag gccaaggctg cggaacccgc 59760
gccggcaccc aagacgccgg agccacggcg gccgaagcag gggggcaagg ctgaaaagcc 59820
ggccccccgct gcggccccga ccggcttcac cttcaaccca acaccggaca aaaaggatca 59880
accgggctgc atccgatgca agtgtgtcgc tgtcgactcg ttgtacaacg aaatccattc 59940
ccattccgcg ctcaagatgg cttcccctcg gcagttcatc agggctaaat caatctagcc 60000
gacttgtccg gtgaaatggg ctgcactcca acagaaacaa tcaaacaaac atacacagcg 60060
acttattcac acgagctcaa attacaacgg tatatat 60097

<210> 2
<211> 61102
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 2
cctgccagtc agcatcatca caccaaaagt taggcccgaa tagtttgaaa ttagaaagct 60
cgcaattgag gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg 120
atgcccccca tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac 180
tattacgtaa gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga 240
cgttacgtaa gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga 300
cgttacgtaa cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt 360
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa 420
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag 480
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa 540
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa 600
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac 660
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa 720
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt 780
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca 840
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac 900
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc 960
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtactgttta 1020
agcttcactg tctctgaatc ggcaaaggta aacgtatcaa ttattctaca aaccctttta 1080
tttttctttt gaattaccgt cttcattggt tatatgataa cttgataagt aaagcttcaa 1140
taattgaatt tgatctgtgt ttttttggcc ttaatactaa atccttacat aagctttgtt 1200
gcttctcctc ttgtgagttg agtgttaagt tgtaataatg gttcactttc agctttagaa 1260
gaaaccatgg aagttgttga gaggttctac ggagagttgg atggaaaggt ttcccaagga 1320
gtgaacgctt tgttgggatc tttcggagtt gagttgactg ataccccaac tactaaggga 1380
ttgccactcg ttgattctcc aactccaatt gtgttgggag tgtctgttta cttgaccatc 1440
gtgatcggag gattgctttg gatcaaggct agagatctca agccaagagc ttctgagcca 1500
ttcttgttgc aagctttggt gttggtgcac aacttgttct gcttcgcttt gtctctttac 1560
atgtgcgtgg gtatcgctta ccaagctatc acctggagat attccttgtg ggaaaacgct 1620
tataacccaa agcacaagga gatggctatc ctcgtttacc tcttctacat gtccaagtac 1680
gtggagttca tggataccgt gatcatgatc ctcaagagat ccaccagaca gatttctttc 1740
ctccacgtgt accaccactc ttctatctcc cttatctggt gggctattgc tcaccacgct 1800
ccaggaggag aggcttattg gagtgctgct ctcaactctg gagtgcacgt gttgatgtac 1860
gcttactact tcttggctgc ttgcttgaga tcttccccaa agctcaagaa caagtacctc 1920
ttctggggaa gatacctcac ccaattccag atgttccagt tcatgctcaa cttggtgcaa 1980
gcttactacg atatgaaaac caacgctcca tatccacaat ggctcatcaa gatcctcttc 2040
tactacatga tctccctctt gttcctcttc ggaaacttct acgtgcaaaa gtacatcaag 2100
ccatccgatg gaaagcaaaa gggagctaag accgagtgat cgacaagctc gagtttctcc 2160
ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg gtttcgctca 2220
tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata cttctatcaa 2280
taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc ccgaattaat 2340
tcggcgttaa ttcagctagc tagcctcagc tgacgttacg taacgctagg tagcgtcacg 2400
tgacgttagc taacgctagg tagcgtcagc tgagcttacg taagcgctta gcagatattt 2460
ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg 2520
gacaacgttg ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca 2580
tgagttgcaa attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg 2640
agagagtctt tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag 2700
tctttttggt gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag 2760
gctgtaaaag attgtaaaag actatttgg tgttttggat aaaatgatag tttttataga 2820

ttcttttgct tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg 2880
aaatcgattg aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt 2940
ctctccattt ttatacctat ttaaccgtaa tcgattctaa tagatgatcg atttttttata 3000
taatcctaat taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat 3060
agaatcagta ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt 3120
tttaattttt ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc 3180
aaggtaagag aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa 3240
atgtacactt gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt 3300
attaaaatac cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa 3360
aagaacccac gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac 3420
tatataaacc caccatcccc aatctcacca aacccaccac acaactcaca actcactctc 3480
acaccttaaa gaaccaatca ccaccaaaaa atttcacgat ttggaatttg attcctgcga 3540
tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt ctttgtgatg 3600
ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga 3660
aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca tgttctttgt 3720
tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt cttactgatc 3780
gttattagga gtttggggaa aaaggaagag tttttttggt tggttcgagt gattatgagg 3840
ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac catgggaaaa 3900
ggatctgagg gaagatctgc tgctagagag atgactgctg aggctaacgg agataagaga 3960
aagaccatcc tcattgaggg agtgttgtac gatgctacca acttcaaaca cccaggaggt 4020
tccattatta acttcctcac cgagggagaa gctggagttg atgctaccca agcttacaga 4080
gagttccatc agagatccgg aaaggctgat aagtacctca agtccctccc aaagttggat 4140
gcttctaagg tggagtctag gttctctgct aaggagcagg ctagaaggga cgctatgacc 4200
agggattacg ctgctttcag agaggagttg gttgctgagg gatacttcga tccatctatc 4260
ccacacatga tctacagagt ggtggagatt gtggctttgt tcgctttgtc tttctggttg 4320
atgtctaagg cttctccaac ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa 4380
ggaagatgcg gatgggttat gcacgagatg ggacacggat ctttcactgg agttatctgg 4440
ctcgatgata ggatgtgcga gttcttctac ggagttggat gtggaatgtc tggacactac 4500
tggaagaacc agcactctaa gcaccacgct gctccaaaca gattggagca cgatgtggat 4560
ttgaacacct tgccactcgt tgctttcaac gagagagttg tgaggaaggt taagccagga 4620
tctttgttgg ctttgtggct cagagttcag gcttatttgt tcgctccagt gtcttgcttg 4680
ttgatcggat tgggatggac cttgtacttg cacccaagat atatgctcag gaccaagaga 4740
cacatggagt ttgtgtggat cttcgctaga tatatcggat ggttctcctt gatgggagct 4800
ttgggatatt ctcctggaac ttctgtggga atgtacctct gctctttcgg acttggatgc 4860
atctacatct tcctccaatt cgctgtgtct cacacccact tgccagttac caacccagag 4920
gatcaattgc actggcttga gtacgctgct gatcacaccg tgaacatctc taccaagtct 4980
tggttggtta cctggtggat gtctaacctc aacttccaaa tcgagcacca cttgttccca 5040
accgctccac aattcaggtt caaggagatc tctccaagag ttgaggctct cttcaagaga 5100
cacaacctcc cttactacga tttgccatac acctctgctg tttctactac cttcgctaac 5160
ctctactctg ttggacactc tgttggagct gataccaaga agcaggattg actgctttaa 5220
tgagatatgc gagacgccta tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt 5280
gtaaaaaacc tgagcatgtg tagctcagat ccttaccgcc ggtttcggtt cattctaatg 5340
aatatatcac ccgttactat cgtattttta tgaataatat tctccgttca atttactgat 5400
tgtctacgta ggctcagctg agcttaccta aggctacgta ggctcacgtg acgttacgta 5460
aggctacgta gcgtcacgtg agcttaccta actctagcta gcctcacgtg accttagcta 5520
acactaggta gcgtcagctc gacggcccgg actgtatcca acttctgatc tttgaatctc 5580
tctgttccaa catgttctga aggagttcta agacttttca gaaagcttgt aacatgcttt 5640
gtagactttc tttgaattac tcttgcaaac tctgattgaa cctacgtgaa aactgctcca 5700
gaagttctaa ccaaattccg tcttgggaag gcccaaaatt tattgagtac ttcagtttca 5760
tggacgtgtc ttcaaagatt tataacttga aatcccatca tttttaagag aagttctgtt 5820
ccgcaatgtc ttagatctca ttgaaatcta caactcttgt gtcagaagtt cttccagaat 5880
caacttgcat catggtgaaa atctggccag aagttctgaa cttgtcatat ttcttaacag 5940
ttagaaaaat ttctaagtgt ttagaatttt gacttttcca aagcaaactt gacttttgac 6000
tttcttaata aaacaaactt catattctaa catgtcttga tgaaatgtga ttcttgaaat 6060
ttgatgttga tgcaaaagtc aaagtttgac ttttcagtgt gcaattgacc attttgctct 6120
tgtgccaatt ccaaacctaa attgatgtat cagtgctgca aacttgatgt catggaagat 6180
cttatgagaa aattcttgaa gactgagagg aaaaatttttg tagtacaaca caaagaatcc 6240
tgtttttcat agtcggacta gacacattaa cataaaacac cacttcattc gaagagtgat 6300
tgaagaagga aatgtgcagt tacctttctg cagttcataa gagcaactta cagacacttt 6360
tactaaaata ctacaaagag gaagatttta acaacttaga gaagtaatgg gagttaaaga 6420
gcaacacatt aagggggagt gttaaaatta atgtgttgta accaccacta cctttagtaa 6480
gtattataag aaaattgtaa tcatcacatt ataattattg tccttattta aaattatgat 6540
aaagttgtat cattaagatt gagaaaacca aatagtcctc gtcttgattt ttgaattatt 6600
gttttctatg ttacttttct tcaagcctat ataaaaactt tgtaatgcta aattgtatgc 6660
tggaaaaaaa tgtgtaatga attgaataga aattatggta tttcaaagtc caaaatccat 6720
caatagaaat ttagtacaaa acgtaactca aaaatattct cttattttaa attttacaac 6780
aatataaaaa tattctctta ttttaaattt tacaataata taatttatca cctgtcacct 6840
ttagaatacc accaacaata ttaatactta gatattttat tcttaataat tttgagatct 6900

```
ctcaatatat ctgatattta ttttatattt gtgtcatatt ttcttatgtt ttagagttaa   6960
cccttatatc ttggtcaaac tagtaattca atatatgagt ttgtgaagga cacattgaca   7020
tcttgaaaca ttggttttaa ccttgttgga atgttaaagg taataaaaca ttcagaatta   7080
tgaccatcta ttaatatact tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat   7140
ggtaagctag agtgtcttgc tggcctgtgt atatcaattc catttccaga tggtagaaac   7200
tgccactacg aataattagt cataagacac gtatgttaac acacgtcccc ttgcatgttt   7260
tttgccatat attccgtctc tttctttttc ttcacgtata aaacaatgaa ctaattaata   7320
gagcgatcaa gctgaacagt tctttgcttt cgaagttgcc gcaacctaaa caggtttttc   7380
cttcttcttt cttcttatta actacgacct tgtcctttgc ctatgtaaaa ttactaggtt   7440
ttcatcagtt acactgatta agttcgttat agtggaagat aaaatgccct caaagcattt   7500
tgcaggatat ctttgatttt tcaaagatat ggaactgtag agtttgatag tgttcttgaa   7560
tgtggttgca tgaagttttt ttggtctgca tgttattttt tcctcgaaat atgttttgag   7620
tccaacaagt gattcacttg ggattcagaa agttgttttc tcaatatgta acagtttttt   7680
tctatggaga aaaatcatag ggaccgttgg ttttggcttc tttaattttg agctcagatt   7740
aaacccattt tacccggtgt tcttggcaga attgaaaaca gtacgtagta ccgcgcctac   7800
catgtgtgtt gagaccgaga acaacgatgg aatccctact gtggagatcg ctttcgatgg   7860
agagagagaa agagctgagg ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc   7920
tttggctaag accttcgcta gaagatacgt ggttatcgag ggagttgagt acgatgtgac   7980
cgatttcaaa catcctggag gaaccgtgat tttctacgct ctctctaaca ctggagctga   8040
tgctactgag gctttcaagg agttccacca cagatctaga aaggctagga aggctttggc   8100
tgctttgcct tctagacctg ctaagaccgc taaagtggat gatgctgaga tgctccagga   8160
tttcgctaag tggagaaagg agttggagag ggacggattc ttcaagcctt ctcctgctca   8220
tgttgcttac agattcgctg agttggctgc tatgtacgct ttgggaacct acttgatgta   8280
cgctagatac gttgtgtcct ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg   8340
atgggttcaa cacgagggag gacactcttc tttgaccgga aacatctggt gggataagag   8400
aatccaagct ttcactgctg gattcggatt ggctggatct ggagatatgt ggaactccat   8460
gcacaacaag caccacgcta ctcctcaaaa agtgaggcac gatatggatt tggataccac   8520
tcctgctgtt gctttcttca acaccgctgt ggaggataat agacctaggg gattctctaa   8580
gtactggctc agattgcaag cttggacctt cattcctgtg acttctggat tggtgttgct   8640
cttctggatg ttcttcctcc acccttctaa ggctttgaag ggaggaaagt acgaggagct   8700
tgtgtggatg ttggctgctc acgtgattag aacctggacc attaaggctg ttactggatt   8760
caccgctatg caatcctacg gactcttctt ggctacttct tgggtttccg gatgctactt   8820
gttcgctcac ttctctactt ctcacaccca cttggatgtt gttcctgctg atgagcactt   8880
gtcttgggtt aggtacgctg tggatcacac cattgatatc gatccttctc agggatgggt   8940
taactggttg atgggatact tgaactgcca agtgattcac cacctcttcc cttctatgcc   9000
tcaattcaga caacctgagg tgtccagaag attcgttgct ttcgctaaga agtggaacct   9060
caactacaag gtgatgactt atgctggagc ttggaaggct actttgggaa acctcgataa   9120
tgtgggaaag cactactacg tgcacggaca acactctgga aagaccgctt gattaatgaa   9180
ggccgcctcg accgtacccc ctgcagatag actatactat gttttagcct gcctgctggc   9240
tagctactat gttatgttat gttgtaaaat aaacacctgc taaggtatat ctatctatat   9300
tttagcatgg ctttctcaat aaattgtctt tccttatcgt ttactatctt atacctaata   9360
atgaaataat aatatcacat atgaggaacg gggcaggttt aggcatatat atacgagtgt   9420
agggcggagt ggggctacgt agcgtcacgt gacgttacct aagcctaggt agcctcagct   9480
gacgttacgt aacgctaggt aggctcagct gacacgggca ggacataggg actactacaa   9540
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa   9600
agtgctagag ggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca   9660
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg   9720
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa   9780
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat   9840
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc   9900
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag   9960
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata  10020
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag  10080
atttgtgcat tttgttgaat ataaattgac aatttttttt atttaattat agattattta  10140
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt  10200
aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca  10260
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt  10320
taatcgggta aaacctgatt actaaatata tattttttat ttgataaaca aaacaaaaat  10380
gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt  10440
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat  10500
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag  10560
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact  10620
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac  10680
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga  10740
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt  10800
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt  10860
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact  10920
tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata  10980
```

tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg 11040
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta 11100
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc 11160
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc 11220
gacattttta tcataaatct ggtgcttaaa cactctggtg agttctagta cttctgctat 11280
gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt tcttgatttt 11340
tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt tttttttgtg 11400
gttaatttag tttcctatgt tcttcgattg tattatgcat gatctgtgtt tggattctgt 11460
tagattatgt attggtgaat atgtatgtgt ttttgcatgt ctggttttgg tcttaaaaat 11520
gttcaaatct gatgatttga ttgaagcttt tttagtgttg gtttgattct tctcaaaact 11580
actgttaatt tactatcatg ttttccaact ttgattcatg atgacacttt tgttctgctt 11640
tgttataaaa ttttggttgg tttgattttg taattatagt gtaattttgt taggaatgaa 11700
catgttttaa tactctgttt tcgatttgtc acacattcga attattaatc gataatttaa 11760
ctgaaaattc atggttctag atcttgttgt catcagatta tttgtttcga taattcatca 11820
aatatgtagt ccttttgctg atttgcgact gtttcatttt ttctcaaaat tgtttttttgt 11880
taagtttatc taacagttat cgttgtcaaa agtctctttc atttgcaaa atcttctttt 11940
tttttttgtt tgtaactttg ttttttaagc tacacattta gtctgtaaaa tagcatcgag 12000
gaacagttgt cttagtagac ttgcatgttc ttgtaacttc tatttgtttc agtttgttga 12060
tgactgcttt gattttgtag gtcaaaggcg caccctacca tggatgctta taacgctgct 12120
atggataaga ttggagctgc tatcatcgat tggagtgatc cagatggaaa gttcagagct 12180
gatagggagg attggtggtt gtgcgatttc agatccgcta tcaccattgc tctcatctac 12240
atcgctttcg tgatcttggg atctgctgtg atgcaatctc tcccagctat ggacccatac 12300
cctatcaagt tcctctacaa cgtgtctcaa atcttcctct gcgcttacat gactgttgag 12360
gctggattcc tcgcttatag gaacggatac accgttatgc catgcaacca cttcaacgtg 12420
aacgatccac cagttgctaa cttgctctgg ctcttctaca tctccaaagt gtgggatttc 12480
tgggatacca tcttcattgt gctcggaaag aagtggagac aactctcttt cttgcacgtg 12540
taccaccaca ccaccatctt cctcttctac tggttgaacg ctaacgtgct ctacgatgga 12600
gatatcttct tgaccatcct cctcaacgga ttcattcaca ccgtgatgta cacctactac 12660
ttcatctgca tgcacaccaa ggattctaag accggaaagt ctttgccaat ctggtggaag 12720
tcatctttga ccgctttcca actcttgcaa ttcaccatca tgatgtccca agctacctac 12780
ttggttttcc acggatgcga taaggtttcc ctcagaatca ccatcgtgta cttcgtgtac 12840
attctctccc ttttcttcct cttcgctcag ttcttcgtgc aatcctacat ggctccaaag 12900
aagaagaagt ccgcttgatg ttaatgaagg ccgcagatat cagatctggt cgacctagag 12960
gatccccggc cgcaaagata ataacaaaag cctactatat aacgtacatg caagtattgt 13020
atgatattaa tgtttttacg tacgtgtaaa caaaaataat tacgtttgta acgtatggtg 13080
atgatgtggt gcactaggtg taggccttgt attaataaaa agaagtttgt tctatataga 13140
gtggtttagt acgacgattt atttactagt cggattggaa tagagaaccg aattcttcaa 13200
tccttgcttt tgatcaagaa ttgaaaccga atcaaatgta aaagttgata tatttgaaaa 13260
acgtattgag cttatgaaaa tgctaatact ctcatctgta tggaaaagtg actttaaaac 13320
cgaacttaaa agtgacaaaa ggggaatatc gcatcaaacc gaatgaaacc gatctacgta 13380
ggctcagctg agcttagcta agcctaccta gcctcacgtg agattatgta aggctaggta 13440
gcgtcacgtg acgttaccta acactagcta gcgtcagctg agcttagcta accctacgta 13500
gcctcacgtg agcttaccta acgctacgta gcctcacgtg actaaggatg acctacccat 13560
tcttgagaca aatgttacat tttagtatca gagtaaaatg tgtacctata actcaaattc 13620
gattgacatg tatccattca acataaaatt aaaccagcct gcacctgcat ccacatttca 13680
agtattttca aaccgttcgg ctcctatcca ccgggtgtaa caagacggat tccgaatttg 13740
gaagattttg actcaaattc ccaatttata ttgaccgtga ctaaatcaac tttaacttct 13800
ataattctga ttaagctccc aatttatatt cccaacggca ctacctccaa aatttataga 13860
ctctcatccc cttttaaacc aacttagtaa acgttttttt tttaatttta tgaagttaag 13920
tttttacctt gtttttaaaa agaatcgttc ataagatgcc atgccagaac attagctaca 13980
cgttacacat agcatgcagc cgcggagaat tgtttttctt cgccacttgt cactcccttc 14040
aaacacctaa gagcttctct ctcacagcac acacatacaa tcacatgcgt gcatgcatta 14100
ttacacgtga tcgccatgca aatctccttt atagcctata aattaactca tcggcttcac 14160
tctttactca aaccaaaact catcaataca aacaagatta aaaacatttc acgatttgga 14220
atttgattcc tgcgatcaca ggtatgacag gttagatttt gttttgtata gttgtataca 14280
tacttctttg tgatgttttg tttacttaat cgaatttttg gagtgtttta aggtctctcg 14340
tttagaaatc gtggaaaata tcactgtgtg tgtgttctta tgattcacag tgtttatggg 14400
tttcatgttc tttgttttat cattgaatgg gaagaaattt cgttgggata caaatttctc 14460
atgttcttac tgatcgttat taggagtttg gggaaaaagg aagagttttt ttggttggtt 14520
cgagtgatta tgaggttatt tctgtatttg atttatgagt taatggtcgt tttaatgttg 14580
tagaccgcca tggctatttt gaaccctgag gctgattctg ctgctaacct cgctactgat 14640
tctgaggcta agcaaagaca attggctgag gctggataca ctcacgttga gggtgctcct 14700
gctcctttgc ctttggagtt gcctcacttc tctctcagag atctcagagc tgctattcct 14760
aagcactgct tcgagagatc tttcgtgacc tccacctact acatgatcaa gaacgtgttg 14820
acttgcgctg ctttgttcta cgctgctacc ttcattgata gagctggagc tgctgcttat 14880
gttttgtggc ctgtgtactg gttcttccag ggatcttact tgactggagt gtgggttatc 14940
gctcacgagt gtggacacca ggcttattgc tcttctgagg tggtgaacaa cttgattgga 15000
ctcgtgttgc actctgcttt gttggtgcct taccactctt ggagaatctc tcacagaaag 15060

```
caccactcca acactggatc ttgcgagaac gatgaggttt tcgttcctgt gaccagatct  15120
gtgttggctt cttcttggaa cgagaccttg gaggattctc ctctctacca actctaccgt  15180
atcgtgtaca tgttggttgt tggatggatg cctggatacc tcttcttcaa cgctactgga  15240
cctactaagt actggggaaa gtctaggtct cacttcaacc cttactccgc tatctatgct  15300
gatagggaga ggtggatgat cgtgctctcc gatattttct tggtggctat gttggctgtt  15360
ttggctgctt tggtgcacac tttctccttc aacacgatgg tgaagttcta cgtggtgcct  15420
tacttcattg tgaacgctta cttggtgttg attacctacc tccaacacac cgatacctac  15480
atccctcact tcagagaggg agagtggaat tggttgagag gagctttgtg cactgtggat  15540
agatcatttg gtccattcct cgattctgtg gtgcatagaa tcgtggatac ccacgtttgc  15600
caccatatct tctccaagat gcctttctat cactgcgagg aggctaccaa cgctattaag  15660
cctctcctcg gaaagttcta cttgaaggat actactcctg ttcctgttgc tctctggaga  15720
tcttacaccc actgcaagtt cgttgaggat gatggaaagg tggtgttcta caagaacaag  15780
ttatagttaa tgaataattg attggttcga gtattatggc attgggaaaa ctgtttttct  15840
tgtaccattt gttgtgcttg taatttactg tgtttttat tcggttttcg ctatcgaact  15900
gtgaaatgga aatggatgga gaagagttaa tgaatgatat ggtccttttg ttcattctca  15960
aattaatatt atttgtttt tctcttattt gttgtgtgtt gaatttgaaa ttataagaga  16020
tatgcaaaca ttttgttttg agtaaaaatg tgtcaaatcg tggcctctaa tgaccgaagt  16080
taatatgagg agtaaaacac ttgtagttgt accattatgc ttattcacta ggcaacaaat  16140
atattttcag acctagaaaa gctgcaaatg ttactgaata caagtatgtc ctcttgtgtt  16200
ttagacattt atgaactttc ctttatgtaa ttttccagaa tccttgtcag attctaatca  16260
ttgctttata attatagtta tactcatgga tttgtagttg agtatgaaaa tattttttaa  16320
tgcattttat gacttgccaa ttgattgaca acatgcatca atgcggccgc tagctagcct  16380
cagctgacgt tacgtaacgc taggtagcgt cacgtgacgt tagctaacgc taggtagcgt  16440
cagctgagct tacgtaagcg ccacgggcag gacataggga ctactacaag catagtatgc  16500
ttcagacaaa gagctaggaa agaactcttg atggaggtta agagaaaaaa gtgctagagg  16560
ggcatagtaa tcaaacttgt caaaaccgtc atcatgatga gggatgacat aatataaaaa  16620
gttgactaag gtcttggtag tactctttga ttagtattat atattggtga gaacatgagt  16680
caagaggaga caagaaaccg aggaaccata gtttagcaac aagatggaag ttgcaaagtt  16740
gagctagccg ctcgattagt tacatctcct aagcagtact acaaggaatg gtctctatac  16800
tttcatgttt agcacatggt agtgcggatt gacaagttag aaacagtgct taggagacaa  16860
agagtcagta aaggtattga aagagtgaag ttgatgctcg acaggtcagg agaagtccct  16920
ccgccagatg gtgactacca aggggttggt atcagctgag acccaaataa gattcttcgg  16980
ttgaaccagt ggttcgaccg agactcttag ggtgggattt cactgtaaga tttgtgcatt  17040
ttgttgaata taaattgaca atttttttta tttaattata gattatttag aatgaattac  17100
atatttagtt tctaacaagg atagcaatgg atgggtatgg gtacaggtta aacatatcta  17160
ttacccaccc atctagtcgt cgggttttac acgtacccac ccgtttacat aaaccagacc  17220
ggaattttaa accgtacccg tccgttagcg ggtttcagat ttacccgttt aatcgggtaa  17280
aacctgatta ctaaatatat attttttatt tgataaacaa aacaaaaatg ttaatatttt  17340
catattggat gcaattttaa gaaacacata ttcataaatt tccatatttg taggaaaata  17400
aaaagaaaaa tatattcaag aacacaaatt tcaccgacat gacttttatt acagagttgg  17460
aattagatct aacaattgaa aaattaaaat taagatagaa tatgttgagg aacatgacat  17520
agtataatgc tgggttaccc gtcgggtagg tatcgaggcg gatactacta aatccatccc  17580
actcgctatc cgataatcac tggtttcggg tatacccatt cccgtcaaca ggccttttta  17640
accggataat ttcaacttat agtgaatgaa ttttgaataa atagttagaa taccaaaatc  17700
ctggattgca tttgcaatca aattttgtga accgttaaat tttgcatgta cttgggatag  17760
atataataga accgaatttt cattagttta atttataact tactttgttc aaagaaaaaa  17820
aatatctatc caatttactt ataataaaaa ataatctatc caagttactt attataatca  17880
acttgtaaaa aggtaagaat acaaatgtgg tagcgtacgt gtgattatat gtgacgaaat  17940
gttatatcta acaaaagtcc aaattcccat ggtaaaaaaa atcaaaatgc atggcaggct  18000
gtttgtaacc ttggaataag atgttggcca attctggagc cgccacgtac gcaagactca  18060
gggccacgtt ctcttcatgc aaggatagta gaacaccact ccacccacct cctatattag  18120
acctttgccc aaccctcccc aactttccca tcccatccac aaagaaaccg acatttttat  18180
cataaatcag ggtttcgttt ttgtttcatc gataaactca aaggtgatga ttttagggtc  18240
ttgtgagtgt gctttttttgt ttgattctac tgtagggttt atgttcttta gctcataggt  18300
tttgtgtatt tcttagaaat gtggcttctt taatctctgg gtttgtgact ttttgtgtgg  18360
tttctgtgtt tttcatatca aaaacctatt ttttccgagt tttttttttac aaattcttac  18420
tctcaagctt gaatacttca catgcagtgt tcttttgtag attttagagt taatgtgtta  18480
aaaagtttgg atttttcttg cttatagagc ttcttcactt tgattttgtg ggttttttttg  18540
ttttaaaggt gagattttttg atgaggtttt tgcttcaaag atgtcacctt tctgggtttg  18600
tcttttgaat aaagctatga actgtcacat ggctgacgca attttgttac tatgtcatga  18660
aagctgacgt ttttccgtgt tatacatgtt tgcttacact tgcatgcgtc aaaaaaattg  18720
gggcttttta gttttagtca aagattttac ttctcttttg ggatttatga aggaaagttg  18780
caaactttct caaattttac catttttgct ttgatgtttg tttagattgc gacagaacaa  18840
actcatatat gttgaaattt ttgcttggtt ttgtatagga ttgtgtcttt tgcttataaa  18900
tgttgaaatc tgaacttttt ttttgtttgg tttctttgag caggagataa ggcgcaccac  18960
catggcttct acatctgctg ctcaagacgc tgctccttac gagttcccctt ctctcactga  19020
gatcaagagg gctcttcctt ctgagtgttt cgaggcttct gttcctcttt ctctctacta  19080
caccgctaga tctcttgctc ttgctggatc tctcgctgtt gctctctctt acgctagagc  19140
```

tttgcctctt gttcaggcta acgctcttct tgatgctact ctctgcactg gatacgttct 19200
tctccaggga atcgttttct ggggattctt caccgttggt cacgattgtg gacacggagc 19260
tttctctaga tctcacgtgc tcaacttctc tgttggaacc ctcatgcact ctatcatcct 19320
taccccttc gagtcttgga agctctctca cagacaccac cacaagaaca ccggaaacat 19380
cgataaggac gagatcttct accctcaaag agaggctgat tctcaccctg tttctagaca 19440
ccttgtgatg tctcttggat ctgcttggtt cgcttacctt ttcgctggat tccctcctag 19500
aaccatgaac cacttcaacc cttgggaggc tatgtatgtt agaagagtgg ctgctgtgat 19560
catctctctc ggagttcttt tcgctttcgc tggactctac tcttacctca ccttcgttct 19620
tggattcacc actatggcta tctactactt cggacctctc ttcatcttcg ctaccatgct 19680
tgttgttacc actttcctcc accacaacga tgaggagaca ccttggtacg ctgattctga 19740
gtggacttac gtgaagggaa acctctcttc tgtggacaga tcttacggtg ctctcatcga 19800
caaccttagc cacaacatcg gaactcacca gatccaccac ctcttcccta tcatccctca 19860
ctacaagctc aacgatgcta ctgctgcttt cgctaaggct ttccctgagc ttgttaggaa 19920
aaacgctgct cctatcatcc caactttctt caggatggct gctatgtacg ctaagtacgg 19980
agttgttgac actgatgcta agaccttcac tctcaaggag gctaaggctg ctgctaagac 20040
taagtcatct tgatgattaa tgaaggccgc agatatcaga tctggtcgac ctagaggatc 20100
cccggccgca aagataataa caaaagccta ctatataacg tacatgcaag tattgtatga 20160
tattaatgtt tttacgtacg tgtaaacaaa aataattacg tttgtaacgt atggtgatga 20220
tgtggtgcac taggtgtagg ccttgtatta ataaaaagaa gtttgttcta tatagagtgg 20280
tttagtacga cgatttattt actagtcgga ttggaataga gaaccgaatt cttcaatcct 20340
tgcttttgat caagaattga aaccgaatca aatgtaaaag ttgatatatt tgaaaaacgt 20400
attgagctta tgaaaatgct aatactctca tctgtatgga aaagtgactt taaaaccgaa 20460
cttaaaagtg acaaaagggg aatatcgcat caaaccgaat gaaaccgatc tacgtaggct 20520
cagctgagct tacctaaggc tacgtaggct cacgtgacgt tacgtaaggc tacgtagcgt 20580
cacgtgagct tacctaactc tagctagcct cacgtgacct tagctaacac taggtagcgt 20640
cagcacagat gaatactagc tgttgttcac agttctagtg tctcctcatt acgtgaattc 20700
aagctacgat cactatctca actcctacat aaacatcaga atgctacaaa actatgcaca 20760
aaaacaaaag ctacatctaa tacgtgaatc aattactctc atcacaagaa agaagatttc 20820
aatcaccgtc gagaaggagg attcagttaa ttgaatcaaa gttccgatca aactcgaaga 20880
ctggtgagca cgaggacgac gaagaagagt gtctcgaaga tacaacaagc aagaaatcta 20940
ctgagtgacc tcctgaagtt attggcgcga ttgagagaat caatccgaat taatttcggg 21000
gaaaaagata aattagatac taagcgatgg gcttgggctg ggctaagaaa caggtggcaa 21060
ttgggctgga ggaccccgcg attcatagct tccgatagcc caaaaaaaaa cggataacat 21120
atttatcggg tatttgaatt tcagtgaaat aagatatttt ctttttgtta ggaaaatttt 21180
agaaaataat ggaaattaaa tagcgattat gttacaagat acgatcagca tcgggcagtg 21240
caaaatgcta tagcttccca agatttgatc cttttgggtt atctcctaat gacaattagt 21300
ttaggatttt gaaacttata ttaatactat tatccgacaa cacttgtttc agcttcttat 21360
tttaacattt tttgtttttt tctattcttc ttcccatcag cattttcttt ttaaaaaatt 21420
gaatacttta actttttaaa aatttcacaa tgatcagatg atattatgga agatctcaag 21480
agttaaatgt atccatcttg gggcattaaa accggtgtac gggatgataa atacagactt 21540
tatatcatat gatagctcag taattcatat ttatcacgtt gctaaaaaaa ttataaggta 21600
ctagtagtca acaaaatcaa ttaaagagaa agaaagaaac gcatgtgaag agagtttaca 21660
actggaaaag taaaataaaa attaacgcat gttgaatgct gacatgtcag tatgtccatg 21720
aatccacgta tcaagcgcca ttcatcgatc gtcttcctct ttctaaatga aaacaacttc 21780
acacatcaca acaaacaata cacacaagac cccctctctc tcgttgtctc tctgccagcg 21840
accaaatcga agcttgagaa gaacaagaag ggtcaaaacc atgggaaaag gatctgaggg 21900
aagatctgct gctagagaga tgactgctga ggctaacgga gataagagaa agaccatcct 21960
cattgaggga gtgttgtacg atgctaccaa cttcaaacac ccaggaggtt ccattattaa 22020
cttcctcacc gagggagaag ctggagttga tgctacccaa gcttacagag agttccatca 22080
gagatccgga aaggctgata agtacctcaa gtccctccca aagttggatg cttctaaggt 22140
ggagtctagg ttctctgcta aggagcaggc tagaagggac gctatgacca gggattacgc 22200
tgctttcaga gaggagttgg ttgctgaggg atacttcgat ccatctatcc cacacatgat 22260
ctacagagtg gtggagattg tggctttgtt cgctttgtct ttctggttga tgtctaaggc 22320
ttctccaacc tctttggttt tgggagtggt gatgaacgga atcgctcaag gaagatgcgg 22380
atgggttatg cacgagatgg gacacggatc tttcactgga gttatctggc tcgatgatag 22440
gatgtgcgag ttcttctacg gagttggatg tggaatgtct ggacactact ggaagaacca 22500
gcactctaag caccacgctg ctccaaacag attggagcac gatgtggatt tgaacacctt 22560
gccactcgtt gctttcaacg agagagttgt gaggaaggtt aagccaggat ctttgttggc 22620
tttgtggctc agagttcagg cttatttgtt cgctccagtg tcttgcttgt tgatcggatt 22680
gggatggacc ttgtacttgc acccaagata tatgctcagg accaagagac acatggagtt 22740
tgtgtggatc ttcgctagat atatcggatg gttctccttg atgggagctt tgggatattc 22800
tcctggaact tctgtgggaa tgtacctctg ctctttcgga cttggatgca tctacatctt 22860
cctccaattc gctgtgtctc acacccactt gccagttacc aacccagagg atcaattgca 22920
ctggcttgag tacgctgctg atcacaccgt gaacatctct accaagtctt ggttggttac 22980
ctggtggatg tctaacctca acttccaaat cgagcaccac ttgttcccaa ccgctccaca 23040
attcaggttc aaggagatct ctccaagagt tgaggctctc ttcaagagac acaacctccc 23100
ttactacgat ttgccataca cctctgctgt ttctactacc ttcgctaacc tctactctgt 23160
tggacactct gttggagctg ataccaagaa gcaggattga tgattaatga ataattgatt 23220

gtacatacta tatttttgt ttaccttgtg ttagtttaat gttcagtgtc ctctctttat 23280
tgtggcacgt ctctttgttg tatgttgtgt ctatacaaag ttgaaataat ggaaagaaaa 23340
ggaagagtgt aatttgtttt gttttaagtg tttataaata tatatatata ggtcatttag 23400
atagttctag gtttctataa aactctctct ctggaagtag aatctgtttt tgagaggatc 23460
cagttgccta ctaatctccc ccaaaaccct tcaagcttaa ccttcctctt cacaacaaca 23520
gaggaaacac atctcttgag ctctgagttc tcttctttga gcatgtctat cgctaaactc 23580
atctgcctta tagcttccct cttctcttca tctctctctc tcaccatttc gctgtaaaac 23640
ttattctcct ccctcagcct ctctatctct tccttcagca tctcacaatt cccaccataa 23700
tcgactgagg atgattcacc gtcatcaact tcagactcag cgttgtagtc gtcatgagtc 23760
tcacaagcct tggaccaaga agactcatca tcgcaagttg atgatttatc atgatgcttc 23820
tctgagccgt gtttgctacg tagcgtcacc tgacgttacg taaggctacc taggctcacg 23880
tgacgttacg taacgctacg tagcgtcagg tgaggttagc taacgctagc tagcctcacc 23940
tgacgttagg taaggctacg tagcgtcacc tgagattagc taagcctacc tagactcacg 24000
tgaccttagg taacgctacg tagcgtcaaa gctttacaac gctacacaaa acttataacc 24060
gtaatcacca ttcattaact taactactat cacatgcatt catgaattga aacgagaagg 24120
atgtaaatag ttgggaagtt atctccacgt tgaagagatc gttagcgaga gctgaaagac 24180
cgagggagga gacgccgtca acacggacag agtcgtcgac cctcacatga agtaggagga 24240
atctccgtga ggagccagag agacgtcttt ggtcttcggt ttcgatcctt gatctgacgg 24300
agaagacgag agaagtgcga ctggactccg tgaggaccaa cagagtcgtc ctcggtttcg 24360
atcgtcggta ttggtggaga aggcggagga atctccgtga cgagccagag agatgtcgtc 24420
ggtcttcggt ttcgatcctt gatctgacgg agaagacgag agaagtgcga cgagactccg 24480
tgaggaccaa cagagttgtc ctcggtttcg atcgtcggtt tcggcggaga aggcggagga 24540
atctccgtga ggagccagag agacgtcgtt ggtcttcggt ttcgatcctt gatctgttgg 24600
agaagacgag acaagtggga cgagactcaa cgacggagtc agagacgtcg tcggtcttcg 24660
gtttcggccg agaaggcgga gtcggtcttc ggtttcggcc gagaaggcgg aggagacgtc 24720
ttcgatttgg gtctctcctc ttgacgaaga aaacaaagaa cacgagaaat aatgagaaag 24780
agaacaaaag aaaaaaaaat aaaaataaaa ataaaatttg gtcctcttat gtggtgacac 24840
gtggtttgaa acccaccaaa taatcgatca caaaaaacct aagttaagga tcggtaataa 24900
cctttctaat taattttgat ttatattaaa tcactctttt tatttataaa ccccactaaa 24960
ttatgcgata ttgattgtct aagtacaaaa attctctcga attcaataca catgtttcat 25020
atatttagcc ctgttcattt aatattacta gcgcattttt aatttaaaat tttgtaaact 25080
tttttggtca aagaacattt ttttaattag agacagaaat ctagactctt tatttggaat 25140
aatagtaata aagatatatt aggcaatgag tttatgatgt tatgtttata tagtttattt 25200
cattttaaat tgaaaagcat tatttttatc gaaatgaatc tagtatacaa tcaatattta 25260
tgtttttttca tcagatactt tcctattttt tggcaccttt catcggacta ctgatttatt 25320
tcaatgtgta tgcatgcatg agcatgagta tacacatgtc ttttaaaatg catgtaaagc 25380
gtaacggacc acaaaagagg atccatacaa atacatctca tcgcttcctc tactattctc 25440
cgacacacac actgagcatg gtgcttaaac actctggtga gttccagtac ttctgctatg 25500
atcgatctca ttaccatttc ttaaatttct ctccctaaat attccgagtt cttgattttt 25560
gataacttca ggttttctct ttttgataaa tctggtcttt ccattttttt tttgtggtta 25620
atttagtttc ctatgttctt cgattgtatt atgcatgatc tgtgtttgga ttctgttaga 25680
ttatgtattg gtgaatatgt atgtgttttt gcatgtctgg ttttggtctt aaaaatgttc 25740
aaatctgatg atttgattga agctttttta gtgttggttt gattcttctc aaaactactg 25800
ttaatttact atcatgtttt ccaactttga ttcatgatga cacttttgtt ctgctttgtt 25860
ataaaatttt ggttggtttg attttgtaat tatagtgtaa ttttgttagg aatgaacatg 25920
ttttaatact ctgttttcga tttgtcacac attcgaatta ttaatcgata atttaactga 25980
aaattcatgg ttctagatct tgttgtcatc agattatttg tttcgataat tcatcaaata 26040
tgtagtcctt ttgctgattt gcgactgttt cattttttct caaaattgtt ttttgttaag 26100
tttatctaac agttatcgtt gtcaaaagtc tctttcattt tgcaaaatct tctttttttt 26160
tttgtttgta actttgtttt ttaagctaca catttagtct gtaaaatagc atcgaggaac 26220
agttgtctta gtagacttgc atgttcttgt aacttctatt tgtttcagtt tgttgatgac 26280
tgctttgatt ttgtaggtca aaccgcgcca tgtctgctag cggagctttg ttgcctgcta 26340
tagctttcgc tgcttacgct tacgctacct acgcttatgc tttcgagtgg agccacgcta 26400
acggaatcga taacgtggat gctagagagt ggattggagc tttgtctttg agactccctg 26460
caattgcaac cacaatgtac ctcttgttct gccttgtggg acctagattg atggctaaga 26520
gggaggcttt tgatcctaag ggatttatgc tcgcttacaa cgcttaccaa accgctttca 26580
acgttgtggt gctcggaatg ttcgctagag agatctctgg attgggacaa cctgtttggg 26640
gatctactat gccttggagc gataggaagt ccttcaagat tttgttggga gtgtggctcc 26700
actacaacaa taagtacctc gagttgttgg atactgtgtt catggtggct aggaaaaaga 26760
ccaagcagct ctctttcttg cacgtgtacc accacgcttt gttgatttgg gcttggtggc 26820
ttgtttgtca cctcatggct accaacgatt gcatcgatgc ttatttcgga gctgcttgca 26880
actctttcat ccacatcgtg atgtactcct actacctcat gtctgctttg ggaattaggt 26940
gcccttggaa gagatatatc acccaggctc agatgttgca attcgtgatc gtgttcgctc 27000
acgctgtttt cgtgctcaga caaaagcact gccctgttac tttgccttgg gcacaaatgt 27060
tcgtgatgac aaatatgttg gtgctcttcg gaaacttcta cctcaaggct tactctaaca 27120
agtctagggg agatggagct tcttctgtta agcctgctga gactactaga gcaccttctg 27180
tgagaagaac caggtcaagg aagatcgatt gatagttaat gaactaagtt tgatgtatct 27240
gagtgccaac gtttactttg tctttccttt cttttattgg ttatgattag atgtttacta 27300

tgttctctct ttttcgttat aaataaagaa gttcaattct tctatagttt caaacgcgat 27360
tttaagcgtt tctatttagg tttacatgat ttcttttaca aaatcatctt taaaatacag 27420
tatattttta gttttcataa aatatttaaa gaaatgaaag tttataaaca ttcactccta 27480
ttctctaatt aaggatttgt aaaacaaaaa ttttgtaagc atatcgattt atgcgttttg 27540
tcttaattag ctcactaaat aataaataat agcttatgtt gtgggactgt ttaattacct 27600
aacttagaac taaaatcaac tctttgtgac gcgtctacct agagtcagct gagcttagct 27660
aacgctagct agtgtcagct gacgttacgt aaggctaact agcgtcacgt gaccttacgt 27720
aacgctacgt aggctcagct gagcttagct aaccctagct agtgtcacgt gagcttacgc 27780
tactatagaa aatgtgttat atcgacatga ccagacaaag gggcaacagt taacaaaaca 27840
attaattctt tcatttgaga ttaaggaagg taaggtacta aaaagattaa aaaaaatgag 27900
cttatctctt tgtttctgta ataataatat aagtgtgata aacttttaat ataataattg 27960
taattaggtt ttctacagat gagcaccact cagagacaag ataagaagaa aacaattttg 28020
ttaaacatga ttatagaaac ttttagttaa gtcttgaagt atcaatataa caaaaaaaag 28080
tacacacgac tatgacaata aacccactac cgtcaggtta tcatttcgat gaaatgtttt 28140
gatatcatta aatataacag tcacaaaaaa tcatctaatt ataacaatat aacttataca 28200
tatatttaac taaaaactta gagtttttgt aatgattcta attgatgatt agagtttata 28260
gaaatacaat taaataaaaa atataatttt aaaaaaacat agtaaagtca atgagatcct 28320
ctctgacctc agtgatcatt tagtcatgta tgtacaacaa tcattgttca tcacatgact 28380
gtaaaataaa taaggataaa cttgggaata tatataatat attgtattaa ataaaaaagg 28440
gaaatacaaa tatcaatttt agattcccga gttgacacaa ctcaccatgc acgctgccac 28500
ctcagctccc agctctcgtc acatgtctca tgtcagttag gtctttggtt tttagtcttt 28560
gacacaactc gccatgcatg ttgccacgtg agctcgttcc tcttcccatg atctcaccac 28620
tgggcatgca tgctgccacc tcagctggca cctcttctct atatgtccct agaggccatg 28680
cacagtgcca cctcagcact cctctcagaa cccatacgta cctgccaatc ggcttctctc 28740
cataaatatc tatttaaatt ataactaatt atttcatata cttaattgat gacgtggatg 28800
cattgccatc gttgtttaat aattgttaat tacgacatga taaataaaat gaaagtaaaa 28860
agtacgaaag attttccatt tgttgttgta taaatagaga agtgagtgat gcataatgca 28920
tgaatgcatg accgcgccac catgactgtt ggatacgacg aggagatccc attcgagcaa 28980
gttagggctc ataacaagcc agacgacgct tggtgtgcta ttcacggaca cgtgtacgac 29040
gttaccaagt tcgcttcagt tcacccagga ggagatatta tcttgctcgc tgctggaaag 29100
gaagctactg tcctctacga gacctaccat gttagaggag tgtctgacgc tgtgctcaga 29160
aagtacagaa taggaaagtt gccagacgga caaggaggag ctaacgagaa ggagaagaga 29220
accttgtctg gattgtcctc tgcttcttac tacacctgga actccgattt ctacagagtg 29280
atgagggaga gagttgtggc tagattgaag gagagaggaa aggctagaag aggaggatac 29340
gaactctgga tcaaggcttt cttgctcctt gttggattct ggtcctctct ttactggatg 29400
tgcaccctcg atccatcttt cggagctatc ttggctgcta tgtctttggg agtgttcgct 29460
gcttttgttg gaacctgcat ccaacacgat ggaaaccacg gagctttcgc tcaatctaga 29520
tgggttaaca aggtggcagg atggactttg gatatgatcg gagcttctgg aatgacttgg 29580
gagttccaac acgtgttggg acaccaccca tacactaact tgatcgagga ggagaacgga 29640
ttgcaaaagg tgtccggaaa gaagatggat accaagttgg ctgatcaaga gtctgatcca 29700
gatgtgttct ccacctaccc aatgatgaga ttgcaccctt ggcaccagaa gaggtggtat 29760
cacaggttcc agcacatcta cggacctttc atcttcggat tcatgaccat caacaaggtg 29820
gtgactcaag atgttggagt ggtgttgaga aagagactct tccaaatcga tgctgagtgc 29880
agatatgctt ccccaatgta cgttgctagg ttctggatta tgaaggcttt gaccgtgttg 29940
tatatggttg ctttgccttg ttatatgcaa ggaccttggc acggattgaa actcttcgct 30000
atcgctcact tcacttgcgg agaggttttg gctaccatgt tcatcgtgaa ccacattatc 30060
gagggagtgt cttacgcttc taaggatgct gttaagggaa ctatggctcc accaaagact 30120
atgcacggag tgaccccaat gaacaacact agaaaggagg ttgaggctga ggcttctaag 30180
tctggagctg tggttaagtc tgtgccattg gatgattggg ctgctgttca gtgccaaacc 30240
tctgtgaact ggtctgttgg atcttggttt tggaaccact tctctggagg actcaaccac 30300
caaatcgagc accacctctt cccaggattg tctcacgaga cctactacca catccaagac 30360
gtggttcaat ctacctgtgc tgagtacgga gttccatacc aacacgagcc atctttgtgg 30420
actgcttact ggaagatgct cgaacacctt agacaattgg gaaacgagga gactcacgag 30480
tcatggcaga gagctgcttg attaatgaac taagactccc aaaaccacct tccctgtgac 30540
agttaaaccc tgcttatacc tttcctccta ataatgttca tctgtcacac aaactaaaat 30600
aaataaaatg ggagcaataa ataaaatggg agctcatata tttacaccat ttacactgtc 30660
tattattcac catgccaatt attacttcat aattttaaaa ttatgtcatt tttaaaaatt 30720
gcttaatgat ggaaaggatt attataagtt aaaagtataa catagataaa ctaaccacaa 30780
aacaaatcaa tataaactaa cttactctcc catctaattt ttatttaaat ttctttacac 30840
ttctcttcca tttctatttc tacaacatta tttaacattt ttattgtatt tttcttactt 30900
tctaactcta ttcatttcaa aaatcaatat atgtttatca ccacctctct aaaaaaaact 30960
ttacaatcat tggtccagaa aagttaaatc acgagatggt cattttagca ttaaaacaac 31020
gattcttgta tcactatttt tcagcatgta gtccattctc ttcaaacaaa gacagcggct 31080
atataatcgt tgtgttatat tcagtctaaa acaactacgt agcgtcacgt gacgttacct 31140
aagcctaggt agcctcagct gacgttacgt aacgctaggt aggctcagct gactgcagca 31200
aatttacaca ttgccactaa acgtctaaac ccttgtaatt tgtttttgtt ttactatgtg 31260
tgttatgtat ttgatttgcg ataaattttt atatttggta ctaaatttat aacacctttt 31320
atgctaacgt ttgccaacac ttagcaattt gcaagttgat taattgattc taaattattt 31380

ttgtcttcta aatacatata ctaatcaact ggaaatgtaa atatttgcta atatttctac 31440
tataggagaa ttaaagtgag tgaatatggt accacaaggt ttggagattt aattgttgca 31500
atgctgcatg gatggcatat acaccaaaca ttcaataatt cttgaggata ataatggtac 31560
cacacaagat ttgaggtgca tgaacgtcac gtggacaaaa ggtttagtaa tttttcaaga 31620
caacaatgtt accacacaca agttttgagg tgcatgcatg gatgccctgt ggaaagttta 31680
aaaatatttt ggaaatgatt tgcatggaag ccatgtgtaa aaccatgaca tccacttgga 31740
ggatgcaata atgaagaaaa ctacaaattt acatgcaact agttatgcat gtagtctata 31800
taatgaggat tttgcaatac tttcattcat acacactcac taagttttac acgattataa 31860
tttcttcata gccagtactg tttaagcttc actgtctctg aatcggcaaa ggtaaacgta 31920
tcaattattc tacaaaccct tttatttttc ttttgaatta ccgtcttcat tggttatatg 31980
ataacttgat aagtaaagct tcaataattg aatttgatct gtgttttttt ggccttaata 32040
ctaaatcctt acataagctt tgttgcttct cctcttgtga gttgagtgtt aagttgtaat 32100
aatggttcac tttcagcttt agaagaaacg cgccttccat ggctacaaag gaggcttacg 32160
ttttcccaac tctcaccgag atcaagagat ctctcccaaa ggattgcttc gaggcttctg 32220
tgcctttgtc tctctactac actgtgagat gcttggttat tgctgtggct ttgaccttcg 32280
gattgaacta cgctagagct ttgccagagg ttgagtcttt ctgggctttg gatgctgctt 32340
tgtgcactgg atatatcctc ctccagggaa ttgtgttctg gggattcttc actgttggac 32400
acgatgctgg acacggagct ttctctagat accacctctt gaacttcgtt gtgggaacct 32460
tcatgcactc tctcatcttg accccattcg agtcttggaa gttgacccac agacaccacc 32520
acaagaacac cggaaacatc gatagagatg aggtgttcta cccacagaga aaggctgatg 32580
atcacccatt gtccaggaac ttgatcttgg ctttgggagc tgcttggctt gcttatttgg 32640
tggagggatt cccaccaaga aaggtgaacc acttcaaccc attcgagcca ctttttgtga 32700
gacaagtgtc cgctgtggtt atctctttgc tcgctcactt cttcgttgct ggactctcta 32760
tctacttgtc tctccagttg ggacttaaga ccatggctat ctactactac ggaccagttt 32820
tcgtgttcgg atctatgttg gtgattacca ccttcttgca ccacaacgat gaggagactc 32880
catggtatgc tgattctgag tggacttacg tgaagggaaa cttgtcctct gtggatagat 32940
cttacggtgc tctcatcgat aacctctccc acaacatcgg aactcaccag atccaccacc 33000
tcttcccaat tatcccacac tacaagctca agaaggctac tgctgctttc caccaagctt 33060
tcccagagct tgtgagaaag tccgatgagc caatcatcaa ggctttcttc agagtgggaa 33120
ggttgtatgc taactacgga gtggttgatc aagaggctaa gctcttcact ttgaaggagg 33180
ctaaggctgc tactgaagct gctgctaaga ccaagtctac ctgattaatg aatcgacaag 33240
ctcgagtttc tccataataa tgtgtgagta gttcccagat aagggaatta gggttcctat 33300
agggtttcgc tcatgtgttg agcatataag aaacccttag tatgtatttg tatttgtaaa 33360
atacttctat caataaaatt tctaattcct aaaaccaaaa tccagtacta aaatccagat 33420
cccccgaatt aattcggcgt taattcagct acgtagcgtc acctgacgtt acgtaaggct 33480
acctaggctc acgtgacgtt acgtaacgct acgtagcgtc aggtgaggtt agctaacgct 33540
agctagcctc acctgacgtt aggtaaggct acgtagcgtc acctgagatt agctaagcct 33600
acctagactc acgtgacctt aggtaacgct acgtagcgtc aaagctttac aacgctacac 33660
aaaacttata accgtaatca ccattcatta acttaactac tatcacatgc attcatgaat 33720
tgaaacgaga aggatgtaaa tagttgggaa gttatctcca cgttgaagag atcgttagcg 33780
agagctgaaa gaccgaggga ggagacgccg tcaacacgga cagagtcgtc gaccctcaca 33840
tgaagtagga ggaatctccg tgaggagcca gagagacgtc tttggtcttc ggtttcgatc 33900
cttgatctga cggagaagac gagagaagtg cgactggact ccgtgaggac caacagagtc 33960
gtcctcggtt tcgatcgtcg gtattggtgg agaaggcgga ggaatctccg tgacgagcca 34020
gagagatgtc gtcggtcttc ggtttcgatc cttgatctga cggagaagac gagagaagtg 34080
cgacgagact ccgtgaggac caacagagtt gtcctcggtt tcgatcgtcg gtttcggcgg 34140
agaaggcgga ggaatctccg tgaggagcca gagagacgtc gttggtcttc ggtttcgatc 34200
cttgatctgt tggagaagac gagacaagtg ggacgagact caacgacgga gtcagagacg 34260
tcgtcggtct tcggtttcgg ccgagaaggc ggagtcggtc ttcggtttcg gccgagaagg 34320
cggaggagac gtcttcgatt tgggtctctc ctcttgacga agaaaacaaa gaacacgaga 34380
aataatgaga aagagaacaa aagaaaaaaa aataaaaata aaaataaaat ttggtcctct 34440
tatgtggtga cacgtggttt gaaacccacc aaataatcga tcacaaaaaa cctaagttaa 34500
ggatcggtaa taacctttct aattaatttt gatttatatt aaatcactct ttttatttat 34560
aaaccccact aaattatgcg atattgattg tctaagtaca aaaattctct cgaattcaat 34620
acacatgttt catatattta gccctgttca tttaatatta ctagcgcatt tttaatttaa 34680
aattttgtaa actttttttgg tcaaagaaca tttttttaat tagagacaga aatctagact 34740
ctttatttgg aataatagta ataaagatat attaggcaat gagtttatga tgttatgttt 34800
atatagttta tttcatttta aattgaaaag cattattttt atcgaaatga atctagtata 34860
caatcaatat ttatgttttt tcatcagata ctttcctatt ttttggcacc tttcatcgga 34920
ctactgattt atttcaatgt gtatgcatgc atgagcatga gtatacacat gtcttttaaa 34980
atgcatgtaa agcgtaacgg accacaaaag aggatccata caaatacatc tcatcgcttc 35040
ctctactatt ctccgacaca cacactgagc atggtgctta aacactctgg tgagttctag 35100
tacttctgct atgatcgatc tcattaccat ttcttaaatt tctctcccta aatattccga 35160
gttcttgatt tttgataact tcaggttttc tctttttgat aaatctggtc tttccatttt 35220
tttttttttg tggttaattt agtttcctat gttcttcgat tgtattatgc atgatctgtg 35280
tttggattct gttagattat gtattggtga atatgtatgt gtttttgcat gtctggtttt 35340
ggtcttaaaa atgttcaaat ctgatgattt gattgaagct tttttagtgt tggtttgatt 35400
cttctcaaaa ctactgttaa tttactatca tgttttccaa ctttgattca tgatgacact 35460

tttgttctgc tttgttataa aattttggtt ggtttgattt tgtaattata gtgtaatttt 35520
gttaggaatg aacatgtttt aatactctgt tttcgatttg tcacacattc gaattattaa 35580
tcgataattt aactgaaaat tcatggttct agatcttgtt gtcatcagat tatttgtttc 35640
gataattcat caaatatgta gtccttttgc tgatttgcga ctgtttcatt ttttctcaaa 35700
attgtttttt gttaagttta tctaacagtt atcgttgtca aaagtctctt tcattttgca 35760
aaatcttctt tttttttttg tttgtaactt tgttttttaa gctacacatt tagtctgtaa 35820
aatagcatcg aggaacagtt gtcttagtag acttgcatgt tcttgtaact tctatttgtt 35880
tcagtttgtt gatgactgct ttgattttgt aggtcaaacc gcgccatgcc acctagtgct 35940
gctagtgaag gtggtgttgc tgaacttaga gctgctgaag ttgctagcta cactagaaag 36000
gctgttgacg aaagacctga cctcactata gttggtgacg ctgtttacga cgctaaggct 36060
tttagggacg agcaccctgg tggtgctcac ttcgttagcc ttttcggagg tagggacgct 36120
actgaggctt ttatggaata tcaccgtaga gcttggccta aggctaggat gtctaagttc 36180
ttcgttggtt cacttgacgc tagcgagaag cctactcaag ctgattcagc ttaccttaga 36240
ctttgcgctg aggttaacgc tcttttgcct aagggtagcg gaggattcgc tcctcctagc 36300
tactggctta aggctgctgc tcttgttgtt gctgctgtta gtatagaggg ttatatgctc 36360
cttaggggta agaccctttt gcttagcgtt ttccttggac tcgtgttcgc ttggatagga 36420
cttaatattc agcacgacgc taatcacggt gctcttagta gacactcagt gattaactac 36480
tgcctcggtt acgctcagga ttggataggt ggtaatatgg tgctttggct tcaagagcac 36540
gttgtgatgc accacctcca cactaacgac gttgacgctg atcctgatca aaaggctcac 36600
ggtgttctta gacttaagcc tactgacggt tggatgcctt ggcacgcact tcaacaactc 36660
tatatccttc ctggtgaggc tatgtacgct tttaagcttc ttttcttgga cgcccttgag 36720
cttcttgctt ggaggtggga gggtgagaag attagccctc ttgctagagc tttgttcgct 36780
cctgctgttg cttgtaagct tggattctgg gctagattcg ttgctctccc tctctggctt 36840
caacctactg ttcacactgc tttgtgtatc tgtgctactg tgtgtactgg tagcttctac 36900
ctcgccttct tcttctttat ctctcacaac ttcgacggtg ttggtagcgt tggacctaag 36960
ggatcacttc ctagatcagc tactttcgtt caacgtcagg ttgagactag ctctaacgtt 37020
ggtggttact ggcttggagt tcttaacggt ggacttaact ttcagataga gcaccacttg 37080
ttccctaggc ttcaccactc ttactacgct caaatagctc ctgtggttag gactcacata 37140
gagaagctcg gttttaagta ccgtcacttc cctaccgttg gatctaacct tagctcaatg 37200
cttcagcata tgggtaagat gggaactaga cctggtgctg agaagggtgg taaggctgag 37260
tagtagttaa tgaactaagt ttgatgtatc tgagtgccaa cgtttacttt gtctttcctt 37320
tcttttattg gttatgatta gatgtttact atgttctctc tttttcgtta taaataaaga 37380
agttcaattc ttctatagtt tcaaacgcga ttttaagcgt ttctatttag gtttacatga 37440
tttcttttac aaaatcatct ttaaaataca gtatattttt agttttcata aaatatttaa 37500
agaaatgaaa gtttataaac attcactcct attctctaat taaggatttg taaaacaaaa 37560
attttgtaag catatcgatt tatgcgtttt gtcttaatta gctcactaaa taataaataa 37620
tagcttatgt tgtgggactg tttaattacc taacttagaa ctaaaatcaa ctctttgtgc 37680
tagctagcct cagctgacgt tacgtaacgc taggtagcgt cacgtgacgt tagctaacgc 37740
taggtagcgt cagctgagct tacgtaagcg cacagatgaa tactagctgt tgttcacagt 37800
tctagtgtct cctcattacg tgaattcaag ctacgatcac tatctcaact cctacataaa 37860
catcagaatg ctacaaaact atgcacaaaa acaaaagcta catctaatac gtgaatcaat 37920
tactctcatc acaagaaaga agatttcaat caccgtcgag aaggaggatt cagttaattg 37980
aatcaaagtt ccgatcaaac tcgaagactg gtgagcacga ggacgacgaa gaagagtgtc 38040
tcgaagatac aacaagcaag aaatctactg agtgacctcc tgaagttatt ggcgcgattg 38100
agagaatcaa tccgaattaa tttcggggaa aaagataaat tagatactaa gcgatgggct 38160
tgggctgggc taagaaacag gtggcaattg ggctggagga ccccgcgatt catagcttcc 38220
gatagcccaa aaaaaaacgg ataacatatt tatcgggtat ttgaatttca gtgaaataag 38280
atattttctt tttgttagga aaattttaga aaataatgga aattaaatag cgattatgtt 38340
acaagatacg atcagcatcg ggcagtgcaa aatgctatag cttcccaaga tttgatcctt 38400
ttgggttatc tcctaatgac aattagttta ggattttgaa acttatatta atactattat 38460
ccgacaacac ttgtttcagc ttcttatttt aacatttttt gttttttctt attcttcttc 38520
ccatcagcat tttcttttta aaaaattgaa tactttaact ttttaaaaat ttcacaatga 38580
tcagatgata ttatggaaga tctcaagagt taaatgtatc catcttgggg cattaaaacc 38640
ggtgtacggg atgataaata cagactttat atcatatgat agctcagtaa ttcatattta 38700
tcacgttgct aaaaaaatta taaggtacta gtagtcaaca aaatcaatta aagagaaaga 38760
aagaaacgca tgtgaagaga gtttacaact ggaaaagtaa aataaaaatt aacgcatgtt 38820
gaatgctgac atgtcagtat gtccatgaat ccacgtatca agcgccattc atcgatcgtc 38880
ttcctctttc taaatgaaaa caacttcaca catcacaaca aacaatacac acaagacccc 38940
ctctctctcg ttgtctctct gccagcgacc aaatcgaagc ttgagaagaa caagaagggg 39000
tcaaaccatg gcttctacat ctgctgctca agacgctgct ccttacgagt tcccttctct 39060
cactgagatc aagagggctc ttccttctga gtgtttcgag gcttctgttc ctctttctct 39120
ctactacacc gctagatctc ttgctcttgc tggatctctc gctgttgctc tctcttacgc 39180
tagagctttg cctcttgttc aggctaacgc tcttcttgat gctactctct gcactggata 39240
cgttcttctc cagggaatcg ttttctgggg attcttcacc gttggtcacg attgtggaca 39300
cggagctttc tctagatctc acgtgctcaa cttctctgtt ggaaccctca tgcactctat 39360
catccttacc cctttcgagt cttggaagct ctctcacaga caccaccaca agaacaccgg 39420
aaacatcgat aaggacgaga tcttctaccc tcaaagagag gctgattctc accctgtttc 39480
tagacacctt gtgatgtctc ttggatctgc ttggttcgct tacctttcg ctggattccc 39540

tcctagaacc atgaaccact tcaacccttg ggaggctatg tatgttagaa gagtggctgc 39600
tgtgatcatc tctctcggag ttcttttcgc tttcgctgga ctctactctt acctcacctt 39660
cgttcttgga ttcaccacta tggctatcta ctacttcgga cctctcttca tcttcgctac 39720
catgcttgtt gttaccactt tcctccacca caacgatgag gagacacctt ggtacgctga 39780
ttctgagtgg acttacgtga agggaaacct ctcttctgtg gacagatctt acggtgctct 39840
catcgacaac cttagccaca acatcggaac tcaccagatc caccacctct tccctatcat 39900
ccctcactac aagctcaacg atgctactgc tgctttcgct aaggctttcc ctgagcttgt 39960
taggaaaaac gctgctccta tcatcccaac tttcttcagg atggctgcta tgtacgctaa 40020
gtacggagtt gttgacactg atgctaagac cttcactctc aaggaggcta aggctgctgc 40080
taagactaag tcatcttgat gattaatgaa taattgattg tacatactat atttttgtt 40140
taccttgtgt tagtttaatg ttcagtgtcc tctctttatt gtggcacgtc tctttgttgt 40200
atgttgtgtc tatacaaagt tgaaataatg gaaagaaaag gaagagtgta atttgttttg 40260
ttttaagtgt ttataaatat atatatatag gtcatttaga tagttctagg tttctataaa 40320
actctctctc tggaagtaga atctgttttt gagaggatcc agttgcctac taatctcccc 40380
caaaaccctt caagcttaac cttcctcttc acaacaacag aggaaacaca tctcttgagc 40440
tctgagttct cttctttgag catgtctatc gctaaactca tctgccttat agcttccctc 40500
ttctcttcat ctctctctct caccatttcg ctgtaaaact tattctcctc cctcagcctc 40560
tctatctctt ccttcagcat ctcacaattc ccaccataat cgactgagga tgattcaccg 40620
tcatcaactt cagactcagc gttgtagtcg tcatgagtct cacaagcctt ggaccaagaa 40680
gactcatcat cgcaagttga tgatttatca tgatgcttct ctgagccgtg tttgctagct 40740
agcctcagct gacgttacgt aacgctaggt agcgtcacgt gacgttagct aacgctaggt 40800
agcgtcagct gagcttacgt aagcgcttaa ttaaagtact gatatcggta ccaaatcgaa 40860
tccaaaaatt acggatatga atataggcat atccgtatcc gaattatccg tttgacagct 40920
agcaacgatt gtacaattgc ttctttaaaa aaggaagaaa gaaagaaaga aaagaatcaa 40980
catcagcgtt aacaaacggc cccgttacgg cccaaacggt catatagagt aacggcgtta 41040
agcgttgaaa gactcctatc gaaatacgta accgcaaacg tgtcatagtc agatcccctc 41100
ttccttcacc gcctcaaaca caaaaataat cttctacagc ctatatatac aacccccccct 41160
tctatctctc ctttctcaca attcatcatc tttctttctc tacccccaat tttaagaaat 41220
cctctcttct cctcttcatt ttcaaggtaa atctctctct ctctctctct ctctgttatt 41280
ccttgtttta attaggtatg tattattgct agtttgttaa tctgcttatc ttatgtatgc 41340
cttatgtgaa tatctttatc ttgttcatct catccgttta gaagctataa atttgttgat 41400
ttgactgtgt atctacacgt ggttatgttt atatctaatc agatatgaat ttcttcatat 41460
tgttgcgttt gtgtgtacca atccgaaatc gttgattttt ttcatttaat cgtgtagcta 41520
attgtacgta tacatatgga tctacgtatc aattgttcat ctgtttgtgt ttgtatgtat 41580
acagatctga aaacatcact tctctcatct gattgtgttg ttacatacat agatatagat 41640
ctgttatatc atttttttta ttaattgtgt atatatatat gtgcatagat ctggattaca 41700
tgattgtgat tatttacatg attttgttat ttacgtatgt atatatgtag atctggactt 41760
tttggagttg ttgacttgat tgtatttgtg tgtgtatatg tgtgttctga tcttgatatg 41820
ttatgtatgt gcagctgaac catggcggcg gcaacaacaa caacaacaac atcttcttcg 41880
atctccttct ccaccaaacc atctccttcc tcctccaaat caccattacc aatctccaga 41940
ttctccctcc cattctccct aaaccccaac aaatcatcct cctcctcccg ccgccgcggt 42000
atcaaatcca gctctccctc ctccatctcc gccgtgctca acacaaccac caatgtcaca 42060
accactccct ctccaaccaa acctaccaaa cccgaaacat tcatctcccg attcgctcca 42120
gatcaacccc gcaaaggcgc tgatatcctc gtcgaggctt tagaacgtca aggcgtagaa 42180
accgtattcg cttaccctgg aggtacatca atggagattc accaagcctt aacccgctct 42240
tcctcaatcc gtaacgtcct tcctcgtcac gaacaaggag gtgtattcgc agcagaagga 42300
tacgctcgat cctcaggtaa accaggtatc tgtatagcca cttcaggtcc cggagctaca 42360
aatctcgtta gcggattagc cgatgcgttg ttagatagtg ttcctcttgt agcaatcaca 42420
ggacaagtcc ctcgtcgtat gattggtaca gatgcgtttc aagagactcc gattgttgag 42480
gtaacgcgtt cgattacgaa gcataactat cttgtgatgg atgttgaaga tatcccaagg 42540
attattgaag aggctttctt tttagctact tctggtagac ctggacctgt tttggttgat 42600
gttcctaaag atattcaaca acagcttgcg attcctaatt gggaacaggc tatgagatta 42660
cctggttata tgtctaggat gcctaaacct ccggaagatt ctcatttgga gcagattgtt 42720
aggttgattt ctgagtctaa gaagcctgtg ttgtatgttg gtggtggttg tcttaattct 42780
agcgatgaat tgggtaggtt tgttgagctt acgggcatcc ctgttgcgag tacgttgatg 42840
gggctgggat cttatccttg tgatgatgag ttgtcgttac atatgcttgg aatgcatggg 42900
actgtgtatg caaattacgc tgtggagcat agtgatttgt tgttggcgtt tggggtaagg 42960
tttgatgatc gtgtcacggg taaacttgag gcttttgcta gtagggctaa gattgttcat 43020
attgatattg actcggctga gattgggaag aataagactc ctcatgtgtc tgtgtgtggt 43080
gatgttaagc tggctttgca agggatgaat aaggttcttg agaaccgagc ggaggagctt 43140
aaacttgatt ttggagtttg gaggaatgag ttgaacgtac agaaacagaa gtttccgttg 43200
agctttaaga cgtttgggga agctattcct ccacagtatg cgattaaggt ccttgatgag 43260
ttgactgatg gaaaagccat aataagtact ggtgtcgggc aacatcaaat gtgggcggcg 43320
cagttctaca attacaagaa accaaggcag tggctatcat caggaggcct tggagctatg 43380
ggatttggac ttcctgctgc gattggagcg tctgttgcta accctgatgc gatagttgtg 43440
gatattgacg gagatggaag ttttataatg aatgtgcaag agctagccac tattcgtgta 43500
gagaatcttc cagtgaaggt acttttatta aacaaccagc atcttggcat ggttatgcaa 43560
tgggaagatc ggttctacaa agctaaccga gctcacacat ttctcgggga cccggctcag 43620

gaggacgaga tattcccgaa catgttgctg tttgcagcag cttgcgggat tccagcggcg 43680
agggtgacaa agaaagcaga tctccgagaa gctattcaga caatgctgga tacaccagga 43740
ccttacctgt tggatgtgat ttgtccgcac caagaacatg tgttgccgat gatcccgaat 43800
ggtggcactt tcaacgatgt cataacggaa ggagatggcc ggattaaata ctgagagatg 43860
aaaccggtga ttatcagaac cttttatggt ctttgtatgc atatggtaaa aaaacttagt 43920
ttgcaatttc ctgtttgttt tggtaatttg agtttctttt agttgttgat ctgcctgctt 43980
tttggtttac gtcagactac tactgctgtt gttgtttggt ttcctttctt tcattttata 44040
aataaataat ccggttcggt ttactccttg tgactggctc agtttggtta ttgcgaaatg 44100
cgaatggtaa attgagtaat tgaaattcgt tattagggtt ctaagctgtt ttaacagtca 44160
ctgggttaat atctctcgaa tcttgcatgg aaaatgctct taccattggt ttttaattga 44220
aatgtgctca tatgggccgt ggtttccaaa ttaaataaaa ctacgatgtc atcgagaagt 44280
aaaatcaact gtgtccacat tatcagtttt gtgtatacga tgaaataggg taattcaaaa 44340
tctagcttga tatgcctttt ggttcatttt aaccttctgt aaacattttt tcagattttg 44400
aacaagtaaa tccaaaaaaa aaaaaaaaaa tctcaactca acactaaatt attttaatgt 44460
ataaaagatg cttaaaacat ttggcttaaa agaaagaagc taaaaacata gagaactctt 44520
gtaaattgaa gtatgaaaat atactgaatt gggtattata tgaatttttc tgatttagga 44580
ttcacatgat ccaaaaagga aatccagaag cactaatcag acattggaag taggattaat 44640
cagtgatcag taactattaa attcaattaa ccgcggacat ctacattttt gaattgaaaa 44700
aaaattggta attactcttt ctttttctcc atattgacca tcatactcat tgctgatcca 44760
tgtagatttc ccggacatga agccatttac aattgaatat atcctgccgc cgctgccgct 44820
ttgcacccgg tggagcttgc atgttggttt ctacgcagaa ctgagccggt taggcagata 44880
atttccattg agaactgagc catgtgcacc ttccccccaa cacggtgagc gacggggcaa 44940
cggagtgatc cacatgggac ttttaaacat catccgtcgg atggcgttgc gagagaagca 45000
gtcgatccgt gagatcagtc gaccaattct catgtttgac agcttatcat cgaatttctg 45060
ccattcatcc gcttattatc acttattcag gcgtagcaac caggcgttta agggcaccaa 45120
taactgcctt aaaaaaatta cgccccgccc tgccactcat cgcagtactg ttgtaattca 45180
ttaagcattc tgccgacatg gaagccatca caaacggcat gatgaacctg aatcgccagc 45240
ggcatcagca ccttgtcgcc ttgcgtataa tatttgccca tggtgaaaac gggggcgaag 45300
aagttgtcca tattggccac gtttaaatca aaactggtga aactcaccca gggattggct 45360
gagacgaaaa acatattctc aataaaccct ttagggaaat aggccaggtt ttcaccgtaa 45420
cacgccacat cttgcgaata tatgtgtaga aactgccgga aatcgtcgtg gtattcactc 45480
cagagcgatg aaaacgtttc agtttgctca tggaaaacgg tgtaacaagg gtgaacacta 45540
tcccatatca ccagctcacc gtctttcatt gccatacgga attccggatg agcattcatc 45600
aggcgggcaa gaatgtgaat aaaggccgga taaaacttgt gcttattttt ctttacggtc 45660
tttaaaaagg ccgtaatatc caggacctgc aggggggggg gggcgctgag gtctgcctcg 45720
tgaagaaggt gttgctgact cataccaggc ctgaatcgcc ccatcatcca gccagaaagt 45780
gagggagcca cggttgatga gagctttgtt gtaggtggac cagttggtga ttttgaactt 45840
ttgctttgcc acggaacggt ctgcgttgtc gggaagatgc gtgatctgat ccttcaactc 45900
agcaaaagtt cgatttattc aacaaagccg ccgtcccgtc aagtcagcgt aatgctctgc 45960
cagtgttaca accaattaac caattctgat tagaaaaact catcgagcat caaatgaaac 46020
tgcaatttat tcatatcagg attatcaata ccatattttt gaaaaagccg tttctgtaat 46080
gaaggagaaa actcaccgag gcagttccat aggatggcaa gatcctggta tcggtctgcg 46140
attccgactc gtccaacatc aatacaacct attaatttcc cctcgtcaaa aataaggtta 46200
tcaagtgaga aatcaccatg agtgacgact gaatccggtg agaatggcaa aagcttatgc 46260
atttctttcc agacttgttc aacaggccag ccattacgct cgtcatcaaa atcactcgca 46320
tcaaccaaac cgttattcat tcgtgattgc gcctgagcga gacgaaatac gcgatcgctg 46380
ttaaaaggac aattacaaac aggaatcgaa tgcaaccggc gcaggaacac tgccagcgca 46440
tcaacaatat tttcacctga atcaggatat tcttctaata cctggaatgc tgttttcccg 46500
gggatcgcag tggtgagtaa ccatgcatca tcaggagtac ggataaaatg cttgatggtc 46560
ggaagaggca taaattccgt cagccagttt agtctgacca tctcatctgt aacatcattg 46620
gcaacgctac ctttgccatg tttcagaaac aactctggcg catcgggctt cccatacaat 46680
cgatagattg tcgcacctga ttgcccgaca ttatcgcgag cccatttata cccatataaa 46740
tcagcatcca tgttggaatt taatcgcggc ctcgagcaag acgtttcccg ttgaatatgg 46800
ctcataacac cccttgtatt actgtttatg taagcagaca gttttattgt tcatgatgat 46860
atatttttat cttgtgcaat gtaacatcag agattttgag acacaacgtg gctttccccc 46920
cccccctgc aggtcctgaa cggtctggtt ataggtacat tgagcaactg actgaaatgc 46980
ctcaaaatgt tctttacgat gccattggga tatatcaacg gtggtatatc cagtgatttt 47040
tttctccatt ttagcttcct tagctcctga aaatctcgat aactcaaaaa atacgcccgg 47100
tagtgatctt atttcattat ggtgaaagtt ggaacctctt acgtgccgat caacgtctca 47160
ttttcgccaa aagttggccc agggcttccc ggtatcaaca gggacaccag gatttattta 47220
ttctgcgaag tgatcttccg tcacaggtat ttattcgcga taagctcatg gagcggcgta 47280
accgtcgcac aggaaggaca gagaaagcgc ggatctggga agtgacggac agaacggtca 47340
ggacctggat tggggaggcg gttgccgccg ctgctgctga cggtgtgacg ttctctgttc 47400
cggtcacacc acatacgttc cgccattcct atgcgatgca catgctgtat gccggtatac 47460
cgctgaaagt tctgcaaagc ctgatgggac ataagtccat cagttcaacg gaagtctaca 47520
cgaaggtttt tgcgctggat gtggctgccc ggcaccgggt gcagtttgcg atgccggagt 47580
ctgatgcggt tgcgatgctg aaacaattat cctgagaata aatgccttgg cctttatatg 47640
gaaatgtgga actgagtgga tatgctgttt ttgtctgtta aacagagaag ctggctgtta 47700

tccactgaga agcgaacgaa acagtcggga aaatctccca ttatcgtaga gatccgcatt 47760
attaatctca ggagcctgtg tagcgtttat aggaagtagt gttctgtcat gatgcctgca 47820
agcggtaacg aaaacgattt gaatatgcct tcaggaacaa tagaaatctt cgtgcggtgt 47880
tacgttgaag tggagcggat tatgtcagca atggacagaa caacctaatg aacacagaac 47940
catgatgtgg tctgtccttt tacagccagt agtgctcgcc gcagtcgagc gacagggcga 48000
agccctcgag tgagcgagga agcaccaggg aacagcactt atatattctg cttacacacg 48060
atgcctgaaa aaacttccct tggggttatc cacttatcca cggggatatt tttataatta 48120
ttttttttat agtttttaga tcttcttttt tagagcgcct tgtaggcctt tatccatgct 48180
ggttctagag aaggtgttgt gacaaattgc cctttcagtg tgacaaatca ccctcaaatg 48240
acagtcctgt ctgtgacaaa ttgcccttaa ccctgtgaca aattgccctc agaagaagct 48300
gtttttttcac aaagttatcc ctgcttattg actctttttt atttagtgtg acaatctaaa 48360
aacttgtcac acttcacatg gatctgtcat ggcggaaaca gcggttatca atcacaagaa 48420
acgtaaaaat agcccgcgaa tcgtccagtc aaacgacctc actgaggcgg catatagtct 48480
ctcccgggat caaaaacgta tgctgtatct gttcgttgac cagatcagaa aatctgatgg 48540
caccctacag gaacatgacg gtatctgcga gatccatgtt gctaaatatg ctgaaatatt 48600
cggattgacc tctgcggaag ccagtaagga tatacggcag gcattgaaga gtttcgcggg 48660
gaaggaagtg gtttttatc gccctgaaga ggatgccggc gatgaaaaag gctatgaatc 48720
ttttccttgg tttatcaaac gtgcgcacag tccatccaga gggctttaca gtgtacatat 48780
caacccatat ctcattccct tctttatcgg gttacagaac cggtttacgc agtttcggct 48840
tagtgaaaca aaagaaatca ccaatccgta tgccatgcgt ttatacgaat ccctgtgtca 48900
gtatcgtaag ccggatggct caggcatcgt ctctctgaaa atcgactgga tcatagagcg 48960
ttaccagctg cctcaaagtt accagcgtat gcctgacttc cgccgccgct tcctgcaggt 49020
ctgtgttaat gagatcaaca gcagaactcc aatgcgcctc tcatacattg agaaaaagaa 49080
aggccgccag acgactcata tcgtattttc cttccgcgat atcacttcca tgacgacagg 49140
atagtctgag ggttatctgt cacagatttg agggtggttc gtcacatttg ttctgaccta 49200
ctgagggtaa tttgtcacag ttttgctgtt tccttcagcc tgcatggatt ttctcatact 49260
ttttgaactg taatttttaa ggaagccaaa tttgagggca gtttgtcaca gttgatttcc 49320
ttctctttcc cttcgtcatg tgacctgata tcgggggtta gttcgtcatc attgatgagg 49380
gttgattatc acagtttatt actctgaatt ggctatccgc gtgtgtacct ctacctggag 49440
tttttcccac ggtggatatt tcttcttgcg ctgagcgtaa gagctatctg acagaacagt 49500
tcttctttgc ttcctcgcca gttcgctcgc tatgctcggt tacacggctg cggcgagcgc 49560
tagtgataat aagtgactga ggtatgtgct cttcttatct ccttttgtag tgttgctctt 49620
attttaaaca actttgcggt tttttgatga ctttgcgatt ttgttgttgc tttgcagtaa 49680
attgcaagat ttaataaaaa aacgcaaagc aatgattaaa ggatgttcag aatgaaactc 49740
atggaaacac ttaaccagtg cataaacgct ggtcatgaaa tgacgaaggc tatcgccatt 49800
gcacagttta atgatgacag cccggaagcg aggaaaataa cccggcgctg gagaataggt 49860
gaagcagcgg atttagttgg ggtttcttct caggctatca gagatgccga gaaagcaggg 49920
cgactaccgc acccggatat ggaaattcga ggacgggttg agcaacgtgt tggttataca 49980
attgaacaaa ttaatcatat gcgtgatgtg tttggtacgc gattgcgacg tgctgaagac 50040
gtatttccac cggtgatcgg ggttgctgcc cataaaggtg gcgtttacaa aacctcagtt 50100
tctgttcatc ttgctcagga tctggctctg aaggggctac gtgttttgct cgtggaaggt 50160
aacgaccccc agggaacagc ctcaatgtat cacggatggg taccagatct tcatattcat 50220
gcagaagaca ctctcctgcc tttctatctt ggggaaaagg acgatgtcac ttatgcaata 50280
aagcccactt gctggccggg gcttgacatt attccttcct gtctggctct gcaccgtatt 50340
gaaactgagt taatgggcaa atttgatgaa ggtaaactgc ccaccgatcc acacctgatg 50400
ctccgactgg ccattgaaac tgttgctcat gactatgatg tcatagttat tgacagcgcg 50460
cctaacctgg gtatcggcac gattaatgtc gtatgtgctg ctgatgtgct gattgttccc 50520
acgcctgctg agttgtttga ctacacctcc gcactgcagt ttttcgatat gcttcgtgat 50580
ctgctcaaga acgttgatct taaagggttc gagcctgatg tacgtatttt gcttaccaaa 50640
tacagcaata gtaatggctc tcagtccccg tggatggagg agcaaattcg ggatgcctgg 50700
ggaagcatgg ttctaaaaaa tgttgtacgt gaaacggatg aagttggtaa aggtcagatc 50760
cggatgagaa ctgtttttga acaggccatt gatcaacgct cttcaactgg tgcctggaga 50820
aatgctcttt ctatttggga acctgtctgc aatgaaattt tcgatcgtct gattaaacca 50880
cgctgggaga ttagataatg aagcgtgcgc ctgttattcc aaaacatacg ctcaatactc 50940
aaccggttga agatacttcg ttatcgacac cagctgcccc gatggtggat tcgttaattg 51000
cgcgcgtagg agtaatggct cgcggtaatg ccattacttt gcctgtatgt ggtcgggatg 51060
tgaagtttac tcttgaagtg ctccggggtg atagtgttga gaagacctct cgggtatggt 51120
caggtaatga acgtgaccag gagctgctta ctgaggacgc actggatgat ctcatccctt 51180
cttttctact gactggtcaa cagacaccgg cgttcggtcg aagagtatct ggtgtcatag 51240
aaattgccga tgggagtcgc cgtcgtaaag ctgctgcact taccgaaagt gattatcgtg 51300
ttctggttgg cgagctggat gatgagcaga tggctgcatt atccagattg ggtaacgatt 51360
atcgcccaac aagtgcttat gaacgtggtc agcgttatgc aagccgattg cagaatgaat 51420
ttgctggaaa tatttctgcg ctggctgatg cggaaaatat ttcacgtaag attattaccc 51480
gctgtatcaa caccgccaaa ttgcctaaat cagttgttgc tcttttttct caccccggtg 51540
aactatctgc ccggtcaggt gatgcacttc aaaaagcctt tacagataaa gaggaattac 51600
ttaagcagca ggcatctaac cttcatgagc agaaaaaagc tggggtgata tttgaagctg 51660
aagaagttat cactctttta acttctgtgc ttaaaacgtc atctgcatca agaactagtt 51720
taagctcacg acatcagttt gctcctggag cgacagtatt gtataagggc gataaaatgg 51780

tgcttaacct ggacaggtct cgtgttccaa ctgagtgtat agagaaaatt gaggccattc 51840
ttaaggaact tgaaaagcca gcaccctgat gcgaccacgt tttagtctac gtttatctgt 51900
ctttacttaa tgtcctttgt tacaggccag aaagcataac tggcctgaat attctctctg 51960
ggcccactgt tccacttgta tcgtcggtct gataatcaga ctgggaccac ggtcccactc 52020
gtatcgtcgg tctgattatt agtctgggac cacggtccca ctcgtatcgt cggtctgatt 52080
attagtctgg gaccacggtc ccactcgtat cgtcggtctg ataatcagac tgggaccacg 52140
gtcccactcg tatcgtcggt ctgattatta gtctgggacc atggtcccac tcgtatcgtc 52200
ggtctgatta ttagtctggg accacggtcc cactcgtatc gtcggtctga ttattagtct 52260
ggaaccacgg tcccactcgt atcgtcggtc tgattattag tctgggacca cggtcccact 52320
cgtatcgtcg gtctgattat tagtctggga ccacgatccc actcgtgttg tcggtctgat 52380
tatcggtctg ggaccacggt cccacttgta ttgtcgatca gactatcagc gtgagactac 52440
gattccatca atgcctgtca agggcaagta ttgacatgtc gtcgtaacct gtagaacgga 52500
gtaacctcgg tgtgcggttg tatgcctgct gtggattgct gctgtgtcct gcttatccac 52560
aacattttgc gcacggttat gtggacaaaa tacctggtta cccaggccgt gccggcacgt 52620
ttcctacaag gtagaatccg cctgagtcgc aagggtgact tcgcctatat tggacgacgg 52680
cgcgcagagg gcgacctctt tttgggttac gattgtagga ttatcactaa aacaatacat 52740
gaacatattc aaatggcaat ctctctaagg cattggaaat aaatacaaat aacagttggg 52800
tggagttttt cgacctgagg gcgttaactc ttcaaggaca acaagaccgt ggacgtcgag 52860
cggctctccg acaagcatgt cgcccgcctg gtcaagcaga ccgcactcgc cgccggcgct 52920
tcgataccgt tcgtattggt ccggcgaaac tgtgagtatc cgcatcgtaa tctccgcatg 52980
aacaggtcat gcgaacagaa atcatctcac ggtgcgtttg cctacgtgca gatttgcacc 53040
tcaggtgatt ctaccgagtc ggtgttccaa ggcgcgaaat gcgagcgggt gaggccgacc 53100
agacgccgac aaggttgtgc agatctgcac ttggtgccac gtcgcacaga agaagggaat 53160
cggtctaact cacagatagc atttgaagaa tcgggattta gtgtgatttc gattgaaacg 53220
cgcgtaaccg ttcattaacc aaaaacgtct tgcaacctca cccgcattag gtaatcgtca 53280
cggataaatg gcaatacgcg ccaattaacc gtgacaagag ataacaccgt gagcaaagcc 53340
gctgccatat cccgaaatga tcgcccgtcg gtagatgtta ccattggtga gcatgctgag 53400
cagctcagct ctcagcttca agcgatgagc gaggctttgt ttcctccgac gtcgcacaag 53460
agcttgcgca aattcacctc gggtgaagcc gcacgcttga tgaaaatatc tgactcaact 53520
cttcgaaaga tgacactggc tggcgaaggg ccgcaacctg aactcgccag caacggacgg 53580
cgcttttaca ccctcggtca gataaacgaa atccggcaga tgcttgccgg ctcgactcga 53640
ggacgtgaaa gcattgattt tgtgcctcat cgccgaggtt ctgagcattt gcaagtcgtt 53700
gctgtaacca acttcaaagg tggctctggg aagacgacga cgtccgctca tcttgcacag 53760
tatctggcgt tgcaaggtta cagggttctc gcagtcgatc tcgatccgca ggctagtctt 53820
tcagcactcc tcggcgttct gccagaaact gatgtcggtg caaacgaaac gctctatgcg 53880
gctattcggt acgacgacac acgtcgtccg ttgcgagatg tgatccgacc gacgtatttt 53940
gatggtcttc accttgttcc tggaaatctc gagcttatgg agttcgagca taccaccccg 54000
aaagcattga ctgacaaagg tacgcgcgac ggattgttct tcactcgcgt ggcccaagcc 54060
tttgatgagg tcgccgacga ttacgatgtc gtggtcatcg actgccctcc tcagcttggg 54120
tttttgactc tcagcgggtt gtgtgctgca acatcaatgg taatcaccgt acatcctcag 54180
atgctggata tcgcttccat gagccagttt ctcctcatga cacgcgacct tctgggtgtc 54240
gtgaaagagg cggggggcaa tctccagtac gatttcatac gctatctctt gacgcgctat 54300
gagccccagg acgcgccgca gacgaaagtg acggcactgc tgcgcaacat gttcgaggat 54360
cacgtcctta caaatcctat ggtcaagtcg gcagcggtat ctgatgccgg tttaaccaag 54420
cagacgctct atgagatagg gcgagagaac cttacgcgat cgacatacga ccgggcgatg 54480
gaatctttag atgcggtgaa ttcggagatc gaggctttga tcaagatggc gtgggggcgg 54540
gtctaatgaa aggctttgcg ttcctcacag atctgttggg agctcccaac agacaggtgt 54600
tgattcgccc cctggacatg gggcactgga gaagccgggg taatttgaga cgacgacgca 54660
cgcccatcgc taattggcca gggtgcagtt gtcttgtctt gttgggagct cccaaccaag 54720
cgcatttgca atcaaaaatg cgacgccacg acgccaaacc caagaggccg atatcatgag 54780
ccgcaaagac gcaatcgata ctttgttcct caagaagcaa cctgcgaccg atagagcagc 54840
agtcgacaag tcgaccgctc gtgttcgtac cggagcgatt tcggccatgg gttcgtcttt 54900
gcaagagatg gctgagggcg caaaggctgc agctcggctg caggatcaac tggctacagg 54960
cgaagccgtc gtgtccctgg atccatccat gatcgacggg tcgccgatcg cggatcggct 55020
gccctcagac gtggatccga aattcgagca gcttgaggcg agcatttcgc aggaggggca 55080
gcaggtgccg gttcttgtca gaccgcaccc tgaggctgcc ggtcgatatc agatcgtata 55140
tggaaggcgg cggctgcgcg cggcagtaaa tctgcggaga gaggtttctg ccattgttcg 55200
aaatctcacg gactgtgaac tggtcgtggc ccagggccgc gaaaatctta accgcgctga 55260
cctctcgttc attgagaagg ctctcttcgc cctgcgcctc gaagatgcgg gttttgatag 55320
agccaccatc attgccgcgc tatccactga caaggccgac ctcagccgct acataactgt 55380
agcaaggggc ataccgctga acctcgccac acaaatcggc ccagcgtcga aagcgggtcg 55440
atcgcgttgg gtcgtacttg ccgaggggct tgggaagcct aaggcaacgg acgcaatcga 55500
agcgatgctt gggtcagagc agttcaagca atctgatagc gatacccgct ttaacctcat 55560
tttcaacgcc gtttcaaggc cacctgcgaa gactccaaaa aaggtaaggg cctggagcac 55620
gccaaagggg aaaaaggcag cgacgatccg acaagaaact ggacgaacgg cgctggtttt 55680
cgacgagaga ctggtgccaa cttttggcga atatgtcgct gaccagttgg acagtctgta 55740
cgcccagttc attgaaacca acggaggagg caagctcgac caatagtcag ggtttcatcc 55800
aatttaaagc tccgctcgac tgagatggac tggctctcac cgcaaaagaa aaaggccccc 55860

gaaacggcgt tccggaagac cttctctgta gtctcgcagc taagagaatc gcatttccag 55920
gaatcgtagt caagggtccc gtaagggaaa gcgtcatttc gacgggcgga tttcaattgc 55980
ctaacaaaag gtaaaaggaa atgcagacgc atatctcaac gacgtccttt gggcggcggc 56040
cgatgacact cggccatatt gcaagccaga tggcagcaaa agcggtcgca tcagacactg 56100
tcgcccacaa atggcaggtc ttccagcaca tccgtgaatc ccggggactg atcggagcca 56160
cggaccgctc actctcgatc ctgaacgcgc tgttgacgtt ttacccggag accgccttga 56220
ctggtggtgc cgaactggtc gtatggcctt ctaacgaaca gctgatggct cgcgccaacg 56280
gcatgcccgc cacgacactg cgccggcatc ttgccatact ggttgattgc gggctcatca 56340
ttcgccgcga cagccccaat ggcaagcggt tcgcccgcaa gggaagggga ggggagattg 56400
agcaggccta tgggttcgat ctgtcgccga tcgtcgcgcg ggccgaggag ttccgagatc 56460
tggcccagac agtgcaagct gaaaaaaagg ccttccgggt ggccaaggag cgcttgactc 56520
ttcttcgtcg tgacattgtc aaaatgatcg aaactggcgt cgaagagagc gttcctggaa 56580
actggggaag agttacccag acctatcagg ggatcatcgg ccgcctgcca cgctcggcac 56640
ctcggcagct tgtcgagagt attgggcaag agcttcagga actctgcatc gagatccgtg 56700
acgtattgga atctttcaca aaaacgatga atctggacgc caatgagtcc catatcggtc 56760
gccacaaaca gaattcaaat ccagactcta aatttgaatc tgaatacagc tctggaaaaa 56820
aagatgaagc gggcggcagc gttgcggaaa ccgacaatgt acggagcttg ccgaaacgcg 56880
agctgccttt gggaatcgtg ctggatgcct gccccgaaat gcgggaattg gcccagggag 56940
gtccaattcg gcattggcgc gacttgctgg cggcggctga gcttgcccgg ccgatgctgg 57000
ggattagtcc gagcgcctgg cgggaggccc gcgaaaccat gggcgatcaa cacgcggcga 57060
tcacgctggc ttcgatctat cagcgggccg gtcagatcaa taacgctggg ggctatctgc 57120
gcagcctgac cgaccgggcc aaggatggga agttttcgac ctggccgatg gtcatggcgt 57180
tgctccgggc aaagctggac gagcagaaga atgcagttgg cgctggaaag ccgcgaactg 57240
ctgaggaggt cgaggatgac agccgcctcc acgtatcgga atcgctgctc aaaaacctgc 57300
gaaagccgag atcttggtga tcctctcgct attcagccgc ggcgatgtcg acgtcggtga 57360
tcaacccgga acgtcgggcg cggtcgatca ggttcttgac ggacgagggc gcccatttgg 57420
atccaccgcg cggcgtgcgc tcgtgcagtc tttcaagctg gccggcgatc tcgcggagct 57480
tcaggtctgg gttcgaagaa tggatgccgg ccacaagcgt catcaggcga tcttcgggaa 57540
gacggggagg agattttttc aggagcgctg catccaccag gcgttccgtc accatccact 57600
tcacggctcg gcgaagacgt tctggcgtcc agtcgaggcc ccgctgcttg agcattcggg 57660
cgatgtcgtc ccatgtgtga tccggtcgca tgcgacgaac ggtaggaagc cattggttcg 57720
cggacgcctg aatcctatcg ccatatgccg ctttctgggc cgcggtcatc cttgccagcg 57780
cctccgggcg cttttcccgg atgcccgggt tgccggaaag cttccctagg cacaaacgtt 57840
gactcttgga tcgagctggc agacaaagca ataacccaca cagaggacga ttaatggctg 57900
acgaagagat ccagaatccg ccggacggta ctgctgctgc cgaagttgag ccggctgctc 57960
ctagaggtag aagagcaaag aaagcaccag ccgaaacagc ccgcacggga tcgttcaaat 58020
ccgtgaagcc gaaaacccgc ggcctcagca accgagaaaa actggagaag atcggtcaaa 58080
tcgaagctca ggtcgctggc ggcgcaacct tgaaggacgc cgttaagatc gtgggtattt 58140
ccgttcagac ctattatcaa tggaagagag ctgcggttca acctgtctca cagaatccgg 58200
ccgtgtctgt ttcagttgac gatgaactcg gcgagttcat ccaactcgag gaggaaaatc 58260
ggcggctcag aaagcttcac gctgccgcaa gcactcaggg cgcaagggct gctaaaggaa 58320
gcggaacacg tagaaagcca gtccgcagaa acggtgctga ccccggatga atgtcagcta 58380
ctgggctatc tggacaaggg aaaacgcaag cgcaaagaga aagcaggtag cttgcagtgg 58440
gcttacatgg cgatagctag actgggcggt tttatggaca gcaagcgaac cggaattgcc 58500
agctggggcg ccctctggga aggttgggaa gccctgcaaa gtaaactgga tggctttctt 58560
gccgccaagg atctgatggc gcaggggatc aagatctgat caagagacag gggccggccc 58620
acgctgtcgt ccaatctccc aagacacgcc gccaccgcgc accgtcgcgg cgagctgctc 58680
cccaagccgc tgttcgatgg gcttccaccg cacgaggctg gaccccttgg cgtcatcaag 58740
catcccattt cgcccgctgg cgagcatgac ggggcgccgg tagacgccgg caacgcgctg 58800
gccgtcggcc acggggcgat gctccaggcc ggtatcggcg gcaatgtcct tcgcggcctg 58860
cgccagttcc cgagcccgct gctgcccagc agattccggt gaggatcacg cgctgcccgc 58920
gccgctcggc cagtccctgt tcggccagga agtccgcgcg ctgctgtatc gcctacttgg 58980
cctcactgct aaagcccagg tcgcccaagc ccgagccacc gtcgatcaac tgctggtcaa 59040
gccaggtggc accgatcacg cgggcctgcc gctcgatggg caggtgcgat ttcagctcca 59100
ccgtcacgcc accaagacgc tgggcgtcat agcggcggcc ctgctcgggc agatcgtccg 59160
gcaccttcca tagtccctcg gccacgcaca ccacgatgcc ggcctggtgc agggcttcga 59220
ggcggcgggt gtggcccgca acgacttcca gcggatcacg cccgacacgg cctgacctag 59280
ctcgacgacc aggtgagatc ggtgaccgcg ctagtcaagc aaccggcgtg ccatggcgtt 59340
tacggccaga tcaatcgcag cgccctcgcc ctcgccgtcg ccgtcgccga tgaaccaggc 59400
tgccgacaag cccgtccatg caatgatcca gcgaagaagc cgttcgggct caaacccggt 59460
cgtcgcgacc acaatgctga gtcgagcctc cagcctgccc ggcaggatcg caagcgggcg 59520
accggggtcg ctgagatcgg gattcgtgaa gatgttggca tagtcgaagg tgcgctcgcc 59580
gagcagtccg tgcgggtcga tggccagcca gccgcggtcg ccgaagtcga gcacgttctc 59640
gtggtgcagg tcgccgtgga gcgggcacac ctcgcgcggc gccgccagaa gttggcgcgc 59700
tacgctggcg gcgggcgcaa gtgccgcgtg ctcagcggcc aaccggaaaa gcggctggaa 59760
ccattcctgt agcggatgga gatcgggcgg cggtccggac cgcggcgcgt gcagacgagc 59820
ggcggtgtcg cagaggatcg tggcatcacc gaaccgcgcc gtgcgcgggt cgtcggtgag 59880
ccagagtttc agcaggccgc ccaggcggcc caggtcgcca ttgatgcggg ccagctcgcg 59940

gacgtgctca tagtccacga cgcccgtgat tttgtagccc tggccgacgg ccagcaggta 60000
ggccgacagg ctcatgccgg ccgccgccgc cttttcctca atcgctcttc gttcgtctgg 60060
aaggcagtac accttgatag gtgggctgcc cttcctggtt ggcttggttt catcagccat 60120
ccgcttgccc tcatctgtta cgccggcggt agccggccag cctcgcagag caggattccc 60180
gttgagcacc gccaggtgcg aataagggac agtgaagaag gaacacccgc tcgcgggtgg 60240
gcctacttca cctatcctgc ccggctgacg ccgttggata caccaaggaa agtctacacg 60300
aaccctttgg caaaatcctg tatatcgtgc gaaaaaggat ggatataccg aaaaaatcgc 60360
tataatgacc ccgaagcagg gttatgcagc ggaaaagcgc tgcttccctg ctgttttgtg 60420
gaatatctac cgactggaaa caggcaaatg caggaaatta ctgaactgag gggacaggcg 60480
agagacgatg ccaaagagct acaccgacga gctggccgag tgggttgaat cccgcgcggc 60540
caagaagcgc cggcgtgatg aggctgcggt tgcgttcctg gcggtgaggg cggatgtcga 60600
ggcggcgtta gcgtccggct atgcgctcgt caccatttgg gagcacatgc gggaaacggg 60660
gaaggtcaag ttctcctacg agacgttccg ctcgcacgcc aggcggcaca tcaaggccaa 60720
gcccgccgat gtgcccgcac cgcaggccaa ggctgcggaa cccgcgccgg cacccaagac 60780
gccggagcca cggcggccga agcagggggg caaggctgaa aagccggccc ccgctgcggc 60840
cccgaccggc ttcaccttca acccaacacc ggacaaaaag gatcaaccgg gctgcatccg 60900
atgcaagtgt gtcgctgtcg actcgttgta caacgaaatc cattcccatt ccgcgctcaa 60960
gatggcttcc cctcggcagt tcatcagggc taaatcaatc tagccgactt gtccggtgaa 61020
atgggctgca ctccaacaga aacaatcaaa caaacataca cagcgactta ttcacacgag 61080
ctcaaattac aacggtatat at 61102

<210> 3
<211> 60074
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 3
cctgccagtc agcatcatca caccaaaagt taggcccgaa tagtttgaaa ttagaaagct 60
cgcaattgag gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg 120
atgcccccca tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac 180
tattacgtaa gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga 240
cgttacgtaa gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga 300
cgttacgtaa cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt 360
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa 420
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag 480
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa 540
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa 600
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac 660
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa 720
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt 780
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca 840
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac 900
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc 960
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtactgttta 1020
agcttcactg tctctgaatc ggcaaaggta aacgtatcaa ttattctaca aaccctttta 1080
tttttctttt gaattaccgt cttcattggt tatatgataa cttgataagt aaagcttcaa 1140
taattgaatt tgatctgtgt ttttttggcc ttaatactaa atccttacat aagctttgtt 1200
gcttctcctc ttgtgagttg agtgttaagt tgtaataatg gttcactttc agctttagaa 1260
gaaaccatgg aagttgttga gaggttctac ggagagttgg atggaaaggt ttcccaagga 1320
gtgaacgctt tgttgggatc tttcggagtt gagttgactg ataccccaac tactaaggga 1380
ttgccactcg ttgattctcc aactccaatt gtgttgggag tgtctgttta cttgaccatc 1440
gtgatcggag gattgctttg gatcaaggct agagatctca agccaagagc ttctgagcca 1500
ttcttgttgc aagctttggt gttggtgcac aacttgttct gcttcgcttt gtctctttac 1560
atgtgcgtgg gtatcgctta ccaagctatc acctggagat attccttgtg ggaaacgct 1620
tataacccaa agcacaagga gatggctatc ctcgtttacc tcttctacat gtccaagtac 1680
gtggagttca tggataccgt gatcatgatc ctcaagagat ccaccagaca gatttctttc 1740
ctccacgtgt accaccactc ttctatctcc cttatctggt gggctattgc tcaccacgct 1800
ccaggaggag aggcttattg gagtgctgct ctcaactctg gagtgcacgt gttgatgtac 1860
gcttactact tcttggctgc ttgcttgaga tcttccccaa agctcaagaa caagtacctc 1920
ttctggggaa gatacctcac ccaattccag atgttccagt tcatgctcaa cttggtgcaa 1980
gcttactacg atatgaaaac caacgctcca tatccacaat ggctcatcaa gatcctcttc 2040
tactacatga tctccctctt gttcctcttc ggaaacttct acgtgcaaaa gtacatcaag 2100
ccatccgatg gaaagcaaaa gggagctaag accgagtgat cgacaagctc gagtttctcc 2160
ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg gtttcgctca 2220
tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata cttctatcaa 2280

taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc ccgaattaat 2340
tcggcgttaa ttcagctagc tagcctcagc tgacgttacg taacgctagg tagcgtcacg 2400
tgacgttagc taacgctagg tagcgtcagc tgagcttacg taagcgctta gcagatattt 2460
ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg 2520
gacaacgttg ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca 2580
tgagttgcaa attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg 2640
agagagtctt tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag 2700
tctttttggt gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag 2760
gctgtaaaag attgtaaaag actattttgg tgttttggat aaaatgatag tttttataga 2820
ttcttttgct tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg 2880
aaatcgattg aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt 2940
ctctccattt ttatacctat ttaaccgtaa tcgattctaa tagatgatcg atttttttata 3000
taatcctaat taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat 3060
agaatcagta ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt 3120
tttaattttt ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc 3180
aaggtaagag aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa 3240
atgtacactt gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt 3300
attaaaatac cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa 3360
aagaacccac gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac 3420
tatataaacc caccatcccc aatctcacca aacccaccac acaactcaca actcactctc 3480
acaccttaaa gaaccaatca ccaccaaaaa atttcacgat ttggaatttg attcctgcga 3540
tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt ctttgtgatg 3600
ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga 3660
aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca tgttctttgt 3720
tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt cttactgatc 3780
gttattagga gtttggggaa aaaggaagag ttttttttggt tggttcgagt gattatgagg 3840
ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac catgggaaaa 3900
ggatctgagg gaagatctgc tgctagagag atgactgctg aggctaacgg agataagaga 3960
aagaccatcc tcattgaggg agtgttgtac gatgctacca acttcaaaca cccaggaggt 4020
tccattatta acttcctcac cgagggagaa gctggagttg atgctaccca agcttacaga 4080
gagttccatc agagatccgg aaaggctgat aagtacctca agtccctccc aaagttggat 4140
gcttctaagg tggagtctag gttctctgct aaggagcagg ctagaaggga cgctatgacc 4200
agggattacg ctgctttcag agaggagttg gttgctgagg gatacttcga tccatctatc 4260
ccacacatga tctacagagt ggtggagatt gtggctttgt tcgctttgtc tttctggttg 4320
atgtctaagg cttctccaac ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa 4380
ggaagatgcg gatgggttat gcacgagatg ggacacggat ctttcactgg agttatctgg 4440
ctcgatgata ggatgtgcga gttcttctac ggagttggat gtggaatgtc tggacactac 4500
tggaagaacc agcactctaa gcaccacgct gctccaaaca gattggagca cgatgtggat 4560
ttgaacacct tgccactcgt tgctttcaac gagagagttg tgaggaaggt taagccagga 4620
tctttgttgg ctttgtggct cagagttcag gcttatttgt tcgctccagt gtcttgcttg 4680
ttgatcggat tgggatggac cttgtacttg cacccaagat atatgctcag gaccaagaga 4740
cacatggagt ttgtgtggat cttcgctaga tatatcggat ggttctcctt gatgggagct 4800
ttgggatatt ctcctggaac ttctgtggga atgtacctct gctctttcgg acttggatgc 4860
atctacatct tcctccaatt cgctgtgtct cacacccact tgccagttac caacccagag 4920
gatcaattgc actggcttga gtacgctgct gatcacaccg tgaacatctc taccaagtct 4980
tggttggtta cctggtggat gtctaacctc aacttccaaa tcgagcacca cttgttccca 5040
accgctccac aattcaggtt caaggagatc tctccaagag ttgaggctct cttcaagaga 5100
cacaacctcc cttactacga tttgccatac acctctgctg tttctactac cttcgctaac 5160
ctctactctg ttggacactc tgttggagct gataccaaga agcaggattg actgctttaa 5220
tgagatatgc gagacgccta tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt 5280
gtaaaaaacc tgagcatgtg tagctcagat ccttaccgcc ggtttcggtt cattctaatg 5340
aatatatcac ccgttactat cgtattttta tgaataatat tctccgttca atttactgat 5400
tgtctacgta ggctcagctg agcttaccta aggctacgta ggctcacgtg acgttacgta 5460
aggctacgta gcgtcacgtg agcttaccta actctagcta gcctcacgtg accttagcta 5520
acactaggta gcgtcagctc gacggcccgg actgtatcca acttctgatc tttgaatctc 5580
tctgttccaa catgttctga aggagttcta agacttttca gaaagcttgt aacatgcttt 5640
gtagactttc tttgaattac tcttgcaaac tctgattgaa cctacgtgaa aactgctcca 5700
gaagttctaa ccaaattccg tcttgggaag gcccaaaatt tattgagtac ttcagtttca 5760
tggacgtgtc ttcaaagatt tataacttga aatcccatca tttttaagag aagttctgtt 5820
ccgcaatgtc ttagatctca ttgaaatcta caactcttgt gtcagaagtt cttccagaat 5880
caacttgcat catggtgaaa atctggccag aagttctgaa cttgtcatat ttcttaacag 5940
ttagaaaaat ttctaagtgt ttagaatttt gacttttcca aagcaaactt gacttttgac 6000
tttcttaata aaacaaactt catattctaa catgtcttga tgaaatgtga ttcttgaaat 6060
ttgatgttga tgcaaaagtc aaagtttgac ttttcagtgt gcaattgacc attttgctct 6120
tgtgccaatt ccaaacctaa attgatgtat cagtgctgca aacttgatgt catggaagat 6180
cttatgagaa aattcttgaa gactgagagg aaaaatttg tagtacaaca caaagaatcc 6240
tgtttttcat agtcggacta gacacattaa cataaaacac cacttcattc gaagagtgat 6300
tgaagaagga aatgtgcagt tacctttctg cagttcataa gagcaactta cagacacttt 6360

tactaaaata ctacaaagag gaagatttta acaacttaga gaagtaatgg gagttaaaga 6420
gcaacacatt aagggggagt gttaaaatta atgtgttgta accaccacta cctttagtaa 6480
gtattataag aaaattgtaa tcatcacatt ataattattg tccttattta aaattatgat 6540
aaagttgtat cattaagatt gagaaaacca aatagtcctc gtcttgattt ttgaattatt 6600
gttttctatg ttacttttct tcaagcctat ataaaaactt tgtaatgcta aattgtatgc 6660
tggaaaaaaa tgtgtaatga attgaataga aattatggta tttcaaagtc caaaatccat 6720
caatagaaat ttagtacaaa acgtaactca aaaatattct cttattttaa attttacaac 6780
aatataaaaa tattctctta ttttaaattt tacaataata taatttatca cctgtcacct 6840
ttagaatacc accaacaata ttaatactta gatattttat tcttaataat tttgagatct 6900
ctcaatatat ctgatattta ttttatattt gtgtcatatt ttcttatgtt ttagagttaa 6960
cccttatatc ttggtcaaac tagtaattca atatatgagt ttgtgaagga cacattgaca 7020
tcttgaaaca ttggttttaa ccttgttgga atgttaaagg taataaaaca ttcagaatta 7080
tgaccatcta ttaatatact tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat 7140
ggtaagctag agtgtcttgc tggcctgtgt atatcaattc catttccaga tggtagaaac 7200
tgccactacg aataattagt cataagacac gtatgttaac acacgtcccc ttgcatgttt 7260
tttgccatat attccgtctc tttctttttc ttcacgtata aaacaatgaa ctaattaata 7320
gagcgatcaa gctgaacagt tctttgcttt cgaagttgcc gcaacctaaa caggtttttc 7380
cttcttcttt cttcttatta actacgacct tgtcctttgc ctatgtaaaa ttactaggtt 7440
ttcatcagtt acactgatta agttcgttat agtggaagat aaaatgccct caaagcattt 7500
tgcaggatat ctttgatttt tcaaagatat ggaactgtag agtttgatag tgttcttgaa 7560
tgtggttgca tgaagttttt ttggtctgca tgttattttt tcctcgaaat atgttttgag 7620
tccaacaagt gattcacttg ggattcagaa agttgtttc tcaatatgta acagtttttt 7680
tctatggaga aaaatcatag ggaccgttgg ttttggcttc tttaattttg agctcagatt 7740
aaacccattt tacccggtgt tcttggcaga attgaaaaca gtacgtagta ccgcgcctac 7800
catgtgtgtt gagaccgaga acaacgatgg aatccctact gtggagatcg ctttcgatgg 7860
agagagagaa agagctgagg ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc 7920
tttggctaag accttcgcta gaagatacgt ggttatcgag ggagttgagt acgatgtgac 7980
cgatttcaaa catcctggag gaaccgtgat tttctacgct ctctctaaca ctggagctga 8040
tgctactgag gctttcaagg agttccacca cagatctaga aaggctagga aggctttggc 8100
tgctttgcct tctagacctg ctaagaccgc taaagtggat gatgctgaga tgctccagga 8160
tttcgctaag tggagaaagg agttggagag ggacggattc ttcaagcctt ctcctgctca 8220
tgttgcttac agattcgctg agttggctgc tatgtacgct ttgggaacct acttgatgta 8280
cgctagatac gttgtgtcct ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg 8340
atgggttcaa cacgagggag gacactcttc tttgaccgga aacatctggt gggataagag 8400
aatccaagct ttcactgctg gattcggatt ggctggatct ggagatatgt ggaactccat 8460
gcacaacaag caccacgcta ctcctcaaaa agtgaggcac gatatggatt tggataccac 8520
tcctgctgtt gctttcttca acaccgctgt ggaggataat agacctaggg gattctctaa 8580
gtactggctc agattgcaag cttggacctt cattcctgtg acttctggat tggtgttgct 8640
cttctggatg ttcttcctcc acccttctaa ggctttgaag ggaggaaagt acgaggagct 8700
tgtgtggatg ttggctgctc acgtgattag aacctggacc attaaggctg ttactggatt 8760
caccgctatg caatcctacg gactcttctt ggctacttct tgggtttccg gatgctactt 8820
gttcgctcac ttctctactt ctcacaccca cttggatgtt gttcctgctg atgagcactt 8880
gtcttgggtt aggtacgctg tggatcacac cattgatatc gatccttctc agggatgggt 8940
taactggttg atgggatact tgaactgcca agtgattcac cacctcttcc cttctatgcc 9000
tcaattcaga caacctgagg tgtccagaag attcgttgct ttcgctaaga agtggaacct 9060
caactacaag gtgatgactt atgctggagc ttggaaggct actttgggaa acctcgataa 9120
tgtgggaaag cactactacg tgcacggaca acactctgga aagaccgctt gattaatgaa 9180
ggccgcctcg accgtacccc ctgcagatag actatactat gttttagcct gcctgctggc 9240
tagctactat gttatgttat gttgtaaaat aaacacctgc taaggtatat ctatctatat 9300
tttagcatgg ctttctcaat aaattgtctt tccttatcgt ttactatctt atacctaata 9360
atgaaataat aatatcacat atgaggaacg gggcaggttt aggcatatat atacgagtgt 9420
agggcggagt ggggctacgt agcgtcacgt gacgttacct aagcctaggt agcctcagct 9480
gacgttacgt aacgctaggt aggctcagct gacacgggca ggacataggg actactacaa 9540
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa 9600
agtgctagag ggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca 9660
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg 9720
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa 9780
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat 9840
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc 9900
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag 9960
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata 10020
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag 10080
atttgtgcat tttgttgaat ataaattgac aattttttt atttaattat agattattta 10140
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt 10200
aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca 10260
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt 10320
taatcgggta aaacctgatt actaaatata tattttttat ttgataaaca aaacaaaaat 10380
gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt 10440

```
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat  10500
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag  10560
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact  10620
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac  10680
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga  10740
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt  10800
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt  10860
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact  10920
tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata  10980
tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg  11040
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta  11100
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc  11160
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc  11220
gacattttta tcataaatct ggtgcttaaa cactctggtg agttctagta cttctgctat  11280
gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt tcttgatttt  11340
tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt tttttgtgg  11400
ttaatttagt ttcctatgtt cttcgattgt attatgcatg atctgtgttt ggattctgtt  11460
agattatgta ttggtgaata tgtatgtgtt tttgcatgtc tggttttggt cttaaaaatg  11520
ttcaaatctg atgatttgat tgaagctttt ttagtgttgg tttgattctt ctcaaaacta  11580
ctgttaattt actatcatgt tttccaactt tgattcatga tgacactttt gttctgcttt  11640
gttataaaat tttggttggt ttgattttgt aattatagtg taattttgtt aggaatgaac  11700
atgttttaat actctgtttt cgatttgtca cacattcgaa ttattaatcg ataatttaac  11760
tgaaaattca tggttctaga tcttgttgtc atcagattat ttgtttcgat aattcatcaa  11820
atatgtagtc cttttgctga tttgcgactg tttcattttt tctcaaaatt gtttttgtt  11880
aagtttatct aacagttatc gttgtcaaaa gtctctttca ttttgcaaaa tcttcttttt  11940
ttttttgttt gtaactttgt tttttaagct acacatttag tctgtaaaat agcatcgagg  12000
aacagttgtc ttagtagact tgcatgttct tgtaacttct atttgtttca gtttgttgat  12060
gactgctttg attttgtagg tcaaaggcgc accctaccat ggatgcttat aacgctgcta  12120
tggataagat tggagctgct atcatcgatt ggagtgatcc agatggaaag ttcagagctg  12180
atagggagga ttggtggttg tgcgatttca gatccgctat caccattgct ctcatctaca  12240
tcgctttcgt gatcttggga tctgctgtga tgcaatctct cccagctatg gacccatacc  12300
ctatcaagtt cctctacaac gtgtctcaaa tcttcctctg cgcttacatg actgttgagg  12360
ctggattcct cgcttatagg aacggataca ccgttatgcc atgcaaccac ttcaacgtga  12420
acgatccacc agttgctaac ttgctctggc tcttctacat ctccaaagtg tgggatttct  12480
gggataccat cttcattgtg ctcggaaaga agtggagaca actctctttc ttgcacgtgt  12540
accaccacac caccatcttc ctcttctact ggttgaacgc taacgtgctc tacgatggag  12600
atatcttctt gaccatcctc ctcaacggat tcattcacac cgtgatgtac acctactact  12660
tcatctgcat gcacaccaag gattctaaga ccggaaagtc tttgccaatc tggtggaagt  12720
catctttgac cgctttccaa ctcttgcaat tcaccatcat gatgtcccaa gctacctact  12780
tggttttcca cggatgcgat aaggtttccc tcagaatcac catcgtgtac ttcgtgtaca  12840
ttctctccct tttcttcctc ttcgctcagt tcttcgtgca atcctacatg gctccaaaga  12900
agaagaagtc cgcttgatgt taatgaaggc cgcagatatc agatctggtc gacctagagg  12960
atccccggcc gcaaagataa taacaaaagc ctactatata acgtacatgc aagtattgta  13020
tgatattaat gtttttacgt acgtgtaaac aaaaataatt acgtttgtaa cgtatggtga  13080
tgatgtggtg cactaggtgt aggccttgta ttaataaaaa gaagtttgtt ctatatagag  13140
tggtttagta cgacgattta tttactagtc ggattggaat agagaaccga attcttcaat  13200
ccttgctttt gatcaagaat tgaaaccgaa tcaaatgtaa aagttgatat atttgaaaaa  13260
cgtattgagc ttatgaaaat gctaatactc tcatctgtat ggaaaagtga ctttaaaacc  13320
gaacttaaaa gtgacaaaag gggaatatcg catcaaaccg aatgaaaccg atctacgtag  13380
gctcagctga gcttagctaa gcctacctag cctcacgtga gattatgtaa ggctaggtag  13440
cgtcacgtga cgttacctaa cactagctag cgtcagctga gcttagctaa ccctacgtag  13500
cctcacgtga gcttacctaa cgctacgtag cctcacgtga ctaaggatga cctacccatt  13560
cttgagacaa atgttacatt ttagtatcag agtaaaatgt gtacctataa ctcaaattcg  13620
attgacatgt atccattcaa cataaaatta aaccagcctg cacctgcatc cacatttcaa  13680
gtattttcaa accgttcggc tcctatccac cgggtgtaac aagacggatt ccgaatttgg  13740
aagattttga ctcaaattcc caatttatat tgaccgtgac taaatcaact ttaacttcta  13800
taattctgat taagctccca atttatattc ccaacggcac tacctccaaa atttatagac  13860
tctcatcccc ttttaaacca acttagtaaa cgtttttttt ttaattttat gaagttaagt  13920
ttttaccttg tttttaaaaa gaatcgttca taagatgcca tgccagaaca ttagctacac  13980
gttacacata gcatgcagcc gcggagaatt gtttttcttc gccacttgtc actcccttca  14040
aacacctaag agcttctctc tcacagcaca cacatacaat cacatgcgtg catgcattat  14100
tacacgtgat cgccatgcaa atctccttta tagcctataa attaactcat cggcttcact  14160
ctttactcaa accaaaactc atcaatacaa acaagattaa aaacatttca cgatttggaa  14220
tttgattcct gcgatcacag gtatgacagg ttagattttg ttttgtatag ttgtatacat  14280
acttctttgt gatgttttgt ttacttaatc gaatttttgg agtgttttaa ggtctctcgt  14340
ttagaaatcg tggaaaatat cactgtgtgt gtgttcttat gattcacagt gtttatgggt  14400
ttcatgttct ttgttttatc attgaatggg aagaaatttc gttgggatac aaatttctca  14460
tgttcttact gatcgttatt aggagtttgg ggaaaaagga agagtttttt tggttggttc  14520
```

gagtgattat gaggttattt ctgtatttga tttatgagtt aatggtcgtt ttaatgttgt 14580
agaccgccat ggctattttg aaccctgagg ctgattctgc tgctaacctc gctactgatt 14640
ctgaggctaa gcaaagacaa ttggctgagg ctggatacac tcacgttgag ggtgctcctg 14700
ctcctttgcc tttggagttg cctcacttct ctctcagaga tctcagagct gctattccta 14760
agcactgctt cgagagatct ttcgtgacct ccacctacta catgatcaag aacgtgttga 14820
cttgcgctgc tttgttctac gctgctacct tcattgatag agctggagct gctgcttatg 14880
ttttgtggcc tgtgtactgg ttcttccagg gatcttactt gactggagtg tgggttatcg 14940
ctcacgagtg tggacaccag gcttattgct cttctgaggt ggtgaacaac ttgattggac 15000
tcgtgttgca ctctgctttg ttggtgcctt accactcttg gagaatctct cacagaaagc 15060
accactccaa cactggatct tgcgagaacg atgaggtttt cgttcctgtg accagatctg 15120
tgttggcttc ttcttggaac gagaccttgg aggattctcc tctctaccaa ctctaccgta 15180
tcgtgtacat gttggttgtt ggatggatgc ctggatacct cttcttcaac gctactggac 15240
ctactaagta ctggggaaag tctaggtctc acttcaaccc ttactccgct atctatgctg 15300
atagggagag gtggatgatc gtgctctccg atattttctt ggtggctatg ttggctgttt 15360
tggctgcttt ggtgcacact ttctccttca acacgatggt gaagttctac gtggtgcctt 15420
acttcattgt gaacgcttac ttggtgttga ttacctacct ccaacacacc gatacctaca 15480
tccctcactt cagagaggga gagtggaatt ggttgagagg agctttgtgc actgtggata 15540
gatcatttgg tccattcctc gattctgtgg tgcatagaat cgtggatacc cacgtttgcc 15600
accatatctt ctccaagatg cctttctatc actgcgagga ggctaccaac gctattaagc 15660
ctctcctcgg aaagttctac ttgaaggata ctactcctgt tcctgttgct ctctggagat 15720
cttacaccca ctgcaagttc gttgaggatg atggaaaggt ggtgttctac aagaacaagt 15780
tatagttaat gaataattga ttggttcgag tattatggca ttgggaaaac tgtttttctt 15840
gtaccatttg ttgtgcttgt aatttactgt gtttttattt cggttttcgc tatcgaactg 15900
tgaaatggaa atggatggag aagagttaat gaatgatatg gtccttttgt tcattctcaa 15960
attaatatta tttgtttttt ctcttatttg ttgtgtgttg aatttgaaat tataagagat 16020
atgcaaacat tttgttttga gtaaaaatgt gtcaaatcgt ggcctctaat gaccgaagtt 16080
aatatgagga gtaaaacact tgtagttgta ccattatgct tattcactag gcaacaaata 16140
tattttcaga cctagaaaag ctgcaaatgt tactgaatac aagtatgtcc tcttgtgttt 16200
tagacattta tgaactttcc tttatgtaat tttccagaat ccttgtcaga ttctaatcat 16260
tgctttataa ttatagttat actcatggat ttgtagttga gtatgaaaat atttttttaat 16320
gcattttatg acttgccaat tgattgacaa catgcatcaa tctagctagc ctcagctgac 16380
gttacgtaac gctaggtagc gtcacgtgac gttagctaac gctaggtagc gtcagctgag 16440
cttacgtaag cgcacagatg aatactagct gttgttcaca gttctagtgt ctcctcatta 16500
cgtgaattca agctacgatc actatctcaa ctcctacata aacatcagaa tgctacaaaa 16560
ctatgcacaa aaacaaaagc tacatctaat acgtgaatca attactctca tcacaagaaa 16620
gaagatttca atcaccgtcg agaaggagga ttcagttaat tgaatcaaag ttccgatcaa 16680
actcgaagac tggtgagcac gaggacgacg aagaagagtg tctcgaagat acaacaagca 16740
agaaatctac tgagtgacct cctgaagtta ttggcgcgat tgagagaatc aatccgaatt 16800
aatttcgggg aaaaagataa attagatact aagcgatggg cttgggctgg gctaagaaac 16860
aggtggcaat tgggctggag gaccccgcga ttcatagctt ccgatagccc aaaaaaaaac 16920
ggataacata tttatcgggt atttgaattt cagtgaaata agatattttc tttttgttag 16980
gaaaatttta gaaaataatg gaaattaaat agcgattatg ttacaagata cgatcagcat 17040
cgggcagtgc aaaatgctat agcttcccaa gatttgatcc ttttgggtta tctcctaatg 17100
acaattagtt taggattttg aaacttatat taatactatt atccgacaac acttgtttca 17160
gcttcttatt ttaacatttt ttgttttttt ctattcttct tcccatcagc attttctttt 17220
taaaaaattg aatactttaa ctttttaaaa atttcacaat gatcagatga tattatggaa 17280
gatctcaaga gttaaatgta tccatcttgg ggcattaaaa ccggtgtacg ggatgataaa 17340
tacagacttt atatcatatg atagctcagt aattcatatt tatcacgttg ctaaaaaaat 17400
tataaggtac tagtagtcaa caaaatcaat taaagagaaa gaaagaaacg catgtgaaga 17460
gagtttacaa ctggaaaagt aaaataaaaa ttaacgcatg ttgaatgctg acatgtcagt 17520
atgtccatga atccacgtat caagcgccat tcatcgatcg tcttcctctt tctaaatgaa 17580
aacaacttca cacatcacaa caaacaatac acacaagacc ccctctctct cgttgtctct 17640
ctgccagcga ccaaatcgaa gcttgagaag aacaagaagg ggtcaaacca tggcttctac 17700
atctgctgct caagacgctg ctccttacga gttcccttct ctcactgaga tcaagagggc 17760
tcttccttct gagtgtttcg aggcttctgt tcctctttct ctctactaca ccgctagatc 17820
tcttgctctt gctggatctc tcgctgttgc tctctcttac gctagagctt tgcctcttgt 17880
tcaggctaac gctcttcttg atgctactct ctgcactgga tacgttcttc tccagggaat 17940
cgttttctgg ggattcttca ccgttggtca cgattgtgga cacggagctt tctctagatc 18000
tcacgtgctc aacttctctg ttggaaccct catgcactct atcatcctta ccccttttcga 18060
gtcttggaag ctctctcaca gacaccacca caagaacacc ggaaacatcg ataaggacga 18120
gatcttctac cctcaaagag aggctgattc tcaccctgtt tctagacacc ttgtgatgtc 18180
tcttggatct gcttggttcg cttacctttt cgctggattc cctcctagaa ccatgaacca 18240
cttcaaccct tgggaggcta tgtatgttag aagagtggct gctgtgatca tctctctcgg 18300
agttcttttc gctttcgctg gactctactc ttacctcacc ttcgttcttg gattcaccac 18360
tatggctatc tactacttcg gacctctctt catcttcgct accatgcttg ttgttaccac 18420
tttcctccac cacaacgatg aggagacacc ttggtacgct gattctgagt ggacttacgt 18480
gaagggaaac ctctcttctg tggacagatc ttacggtgct ctcatcgaca accttagcca 18540
caacatcgga actcaccaga tccaccacct cttccctatc atccctcact acaagctcaa 18600

```
cgatgctact gctgctttcg ctaaggcttt ccctgagctt gttaggaaaa acgctgctcc  18660
tatcatccca actttcttca ggatggctgc tatgtacgct aagtacggag ttgttgacac  18720
tgatgctaag accttcactc tcaaggaggc taaggctgct gctaagacta agtcatcttg  18780
atgattaatg aataattgat tgtacatact atatttttg tttaccttgt gttagtttaa  18840
tgttcagtgt cctctcttta ttgtggcacg tctctttgtt gtatgttgtg tctatacaaa  18900
gttgaaataa tggaaagaaa aggaagagtg taatttgttt tgttttaagt gtttataaat  18960
atatatatat aggtcattta gatagttcta ggtttctata aaactctctc tctggaagta  19020
gaatctgttt ttgagaggat ccagttgcct actaatctcc cccaaaaccc ttcaagctta  19080
accttcctct tcacaacaac agaggaaaca catctcttga gctctgagtt ctcttctttg  19140
agcatgtcta tcgctaaact catctgcctt atagcttccc tcttctcttc atctctctct  19200
ctcaccattt cgctgtaaaa cttattctcc tccctcagcc tctctatctc ttccttcagc  19260
atctcacaat tcccaccata atcgactgag gatgattcac cgtcatcaac ttcagactca  19320
gcgttgtagt cgtcatgagt ctcacaagcc ttggaccaag aagactcatc atcgcaagtt  19380
gatgatttat catgatgctt ctctgagccg tgtttgctac gtagcgtcac gtgacgttac  19440
ctaagcctag gtagcctcag ctgacgttac gtaacgctag gtaggctcag ctgactgcag  19500
caaatttaca cattgccact aaacgtctaa acccttgtaa tttgtttttg ttttactatg  19560
tgtgttatgt atttgatttg cgataaattt ttatatttgg tactaaattt ataacacctt  19620
ttatgctaac gtttgccaac acttagcaat ttgcaagttg attaattgat tctaaattat  19680
ttttgtcttc taaatacata tactaatcaa ctggaaatgt aaatatttgc taatatttct  19740
actataggag aattaaagtg agtgaatatg gtaccacaag gtttggagat ttaattgttg  19800
caatgctgca tggatggcat atacaccaaa cattcaataa ttcttgagga taataatggt  19860
accacacaag atttgaggtg catgaacgtc acgtggacaa aaggtttagt aatttttcaa  19920
gacaacaatg ttaccacaca caagttttga ggtgcatgca tggatgccct gtggaaagtt  19980
taaaaatatt ttggaaatga tttgcatgga agccatgtgt aaaaccatga catccacttg  20040
gaggatgcaa taatgaagaa aactacaaat ttacatgcaa ctagttatgc atgtagtcta  20100
tataatgagg attttgcaat actttcattc atacacactc actaagtttt acacgattat  20160
aatttcttca tagccagtac tgtttaagct tcactgtctc tgaatcggca aaggtaaacg  20220
tatcaattat tctacaaacc cttttatttt tcttttgaat taccgtcttc attggttata  20280
tgataacttg ataagtaaag cttcaataat tgaatttgat ctgtgttttt ttggccttaa  20340
tactaaatcc ttacataagc tttgttgctt ctcctcttgt gagttgagtg ttaagttgta  20400
ataatggttc actttcagct ttagaagaaa cgcgccttcc atggctacaa aggaggctta  20460
cgttttccca actctcaccg agatcaagag atctctccca aaggattgct tcgaggcttc  20520
tgtgcctttg tctctctact acactgtgag atgcttggtt attgctgtgg ctttgacctt  20580
cggattgaac tacgctagag ctttgccaga ggttgagtct ttctgggctt tggatgctgc  20640
tttgtgcact ggatatatcc tcctccaggg aattgtgttc tggggattct tcactgttgg  20700
acacgatgct ggacacggag ctttctctag ataccacctc ttgaacttcg ttgtgggaac  20760
cttcatgcac tctctcatct tgaccccatt cgagtcttgg aagttgaccc acagacacca  20820
ccacaagaac accggaaaca tcgatagaga tgaggtgttc tacccacaga gaaaggctga  20880
tgatcaccca ttgtccagga acttgatctt ggctttggga gctgcttggc ttgcttattt  20940
ggtggaggga ttcccaccaa gaaaggtgaa ccacttcaac ccattcgagc cactttttgt  21000
gagacaagtg tccgctgtgg ttatctcttt gctcgctcac ttcttcgttg ctggactctc  21060
tatctacttg tctctccagt tgggacttaa gaccatggct atctactact acggaccagt  21120
tttcgtgttc ggatctatgt tggtgattac caccttcttg caccacaacg atgaggagac  21180
tccatggtat gctgattctg agtggactta cgtgaaggga aacttgtcct ctgtggatag  21240
atcttacggt gctctcatcg ataacctctc ccacaacatc ggaactcacc agatccacca  21300
cctcttccca attatcccac actacaagct caagaaggct actgctgctt tccaccaagc  21360
tttcccagag cttgtgagaa agtccgatga gccaatcatc aaggctttct tcagagtggg  21420
aaggttgtat gctaactacg gagtggttga tcaagaggct aagctcttca ctttgaagga  21480
ggctaaggct gctactgaag ctgctgctaa gaccaagtct acctgattaa tgaatcgaca  21540
agctcgagtt tctccataat aatgtgtgag tagttcccag ataagggaat tagggttcct  21600
atagggtttc gctcatgtgt tgagcatata agaaaccctt agtatgtatt tgtatttgta  21660
aaatacttct atcaataaaa tttctaattc ctaaaaccaa aatccagtac taaaatccag  21720
atcccccgaa ttaattcggc gttaattcag ctacgtaggc tcagctgagc ttacctaagg  21780
ctacgtaggc tcacgtgacg ttacgtaagg ctacgtagcg tcacgtgagc ttacctaact  21840
ctagctagcc tcacgtgacc ttagctaaca ctaggtagcg tcagcacaga tgaatactag  21900
ctgttgttca cagttctagt gtctcctcat tacgtgaatt caagctacga tcactatctc  21960
aactcctaca taaacatcag aatgctacaa aactatgcac aaaaacaaaa gctacatcta  22020
atacgtgaat caattactct catcacaaga aagaagattt caatcaccgt cgagaaggag  22080
gattcagtta attgaatcaa agttccgatc aaactcgaag actggtgagc acgaggacga  22140
cgaagaagag tgtctcgaag atacaacaag caagaaatct actgagtgac ctcctgaagt  22200
tattggcgcg attgagagaa tcaatccgaa ttaatttcgg ggaaaaagat aaattagata  22260
ctaagcgatg ggcttgggct gggctaagaa acaggtggca attgggctgg aggaccccgc  22320
gattcatagc ttccgatagc ccaaaaaaaa acggataaca tatttatcgg gtatttgaat  22380
ttcagtgaaa taagatattt tctttttgtt aggaaaattt tagaaaataa tggaaattaa  22440
atagcgatta tgttacaaga tacgatcagc atcgggcagt gcaaaatgct atagcttccc  22500
aagatttgat ccttttgggt tatctcctaa tgacaattag tttaggattt tgaaacttat  22560
attaatacta ttatccgaca acacttgttt cagcttctta ttttaacatt ttttgttttt  22620
ttctattctt cttcccatca gcattttctt tttaaaaaat tgaatacttt aactttttaa  22680
```

aaatttcaca atgatcagat gatattatgg aagatctcaa gagttaaatg tatccatctt 22740
ggggcattaa aaccggtgta cgggatgata aatacagact ttatatcata tgatagctca 22800
gtaattcata tttatcacgt tgctaaaaaa attataaggt actagtagtc aacaaaatca 22860
attaaagaga aagaaagaaa cgcatgtgaa gagagtttac aactggaaaa gtaaaataaa 22920
aattaacgca tgttgaatgc tgacatgtca gtatgtccat gaatccacgt atcaagcgcc 22980
attcatcgat cgtcttcctc tttctaaatg aaaacaactt cacacatcac aacaaacaat 23040
acacacaaga ccccctctct ctcgttgtct ctctgccagc gaccaaatcg aagcttgaga 23100
agaacaagaa ggggtcaaac catgggaaaa ggatctgagg gaagatctgc tgctagagag 23160
atgactgctg aggctaacgg agataagaga aagaccatcc tcattgaggg agtgttgtac 23220
gatgctacca acttcaaaca cccaggaggt tccattatta acttcctcac cgagggagaa 23280
gctggagttg atgctaccca agcttacaga gagttccatc agagatccgg aaaggctgat 23340
aagtacctca agtccctccc aaagttggat gcttctaagg tggagtctag gttctctgct 23400
aaggagcagg ctagaaggga cgctatgacc agggattacg ctgctttcag agaggagttg 23460
gttgctgagg gatacttcga tccatctatc ccacacatga tctacagagt ggtggagatt 23520
gtggctttgt tcgctttgtc tttctggttg atgtctaagg cttctccaac ctctttggtt 23580
ttgggagtgg tgatgaacgg aatcgctcaa ggaagatgcg gatgggttat gcacgagatg 23640
ggacacggat ctttcactgg agttatctgg ctcgatgata ggatgtgcga gttcttctac 23700
ggagttggat gtggaatgtc tggacactac tggaagaacc agcactctaa gcaccacgct 23760
gctccaaaca gattggagca cgatgtggat ttgaacacct tgccactcgt tgctttcaac 23820
gagagagttg tgaggaaggt taagccagga tctttgttgg ctttgtggct cagagttcag 23880
gcttatttgt tcgctccagt gtcttgcttg ttgatcggat tgggatggac cttgtacttg 23940
cacccaagat atatgctcag gaccaagaga cacatggagt ttgtgtggat cttcgctaga 24000
tatatcggat ggttctcctt gatgggagct ttgggatatt ctcctggaac ttctgtggga 24060
atgtacctct gctctttcgg acttggatgc atctacatct tcctccaatt cgctgtgtct 24120
cacacccact tgccagttac caacccagag gatcaattgc actggcttga gtacgctgct 24180
gatcacaccg tgaacatctc taccaagtct tggttggtta cctggtggat gtctaacctc 24240
aacttccaaa tcgagcacca cttgttccca accgctccac aattcaggtt caaggagatc 24300
tctccaagag ttgaggctct cttcaagaga cacaacctcc cttactacga tttgccatac 24360
acctctgctg tttctactac cttcgctaac ctctactctg ttggacactc tgttggagct 24420
gataccaaga agcaggattg atgattaatg aataattgat tgtacatact atatttttg 24480
tttaccttgt gttagtttaa tgttcagtgt cctctcttta ttgtggcacg tctctttgtt 24540
gtatgttgtg tctatacaaa gttgaaataa tggaaagaaa aggaagagtg taatttgttt 24600
tgttttaagt gtttataaat atatatatat aggtcattta gatagttcta ggtttctata 24660
aaactctctc tctggaagta gaatctgttt ttgagaggat ccagttgcct actaatctcc 24720
cccaaaaccc ttcaagctta accttcctct tcacaacaac agaggaaaca catctcttga 24780
gctctgagtt ctcttctttg agcatgtcta tcgctaaact catctgcctt atagcttccc 24840
tcttctcttc atctctctct ctcaccattt cgctgtaaaa cttattctcc tccctcagcc 24900
tctctatctc ttccttcagc atctcacaat tcccaccata atcgactgag gatgattcac 24960
cgtcatcaac ttcagactca gcgttgtagt cgtcatgagt ctcacaagcc ttggaccaag 25020
aagactcatc atcgcaagtt gatgatttat catgatgctt ctctgagccg tgtttgctac 25080
ctagagtcag ctgagcttag ctaacgctag ctagtgtcag ctgacgttac gtaaggctaa 25140
ctagcgtcac gtgaccttac gtaacgctac gtaggctcag ctgagcttag ctaaccctag 25200
ctagtgtcac gtgagcttac gctactatag aaaatgtgtt atatcgacat gaccagacaa 25260
aggggcaaca gttaacaaaa caattaattc tttcatttga gattaaggaa ggtaaggtac 25320
taaaaagatt aaaaaaaatg agcttatctc tttgtttctg taataataat ataagtgtga 25380
taaactttta atataataat tgtaattagg ttttctacag atgagcacca ctcagagaca 25440
agataagaag aaaacaattt tgttaaacat gattatagaa acttttagtt aagtcttgaa 25500
gtatcaatat aacaaaaaaa agtacacacg actatgacaa taaacccact accgtcaggt 25560
tatcatttcg atgaaatgtt ttgatatcat taaatataac agtcacaaaa aatcatctaa 25620
ttataacaat ataacttata catatattta actaaaaact tagagttttt gtaatgattc 25680
taattgatga ttagagttta tagaaataca attaaataaa aaatataatt ttaaaaaaac 25740
atagtaaagt caatgagatc ctctctgacc tcagtgatca tttagtcatg tatgtacaac 25800
aatcattgtt catcacatga ctgtaaaata aataaggata aacttgggaa tatatataat 25860
atattgtatt aaataaaaaa gggaaataca aatatcaatt ttagattccc gagttgacac 25920
aactcaccat gcacgctgcc acctcagctc ccagctctcg tcacatgtct catgtcagtt 25980
aggtctttgg tttttagtct ttgacacaac tcgccatgca tgttgccacg tgagctcgtt 26040
cctcttccca tgatctcacc actgggcatg catgctgcca cctcagctgg cacctcttct 26100
ctatatgtcc ctagaggcca tgcacagtgc cacctcagca ctcctctcag aacccatacg 26160
tacctgccaa tcggcttctc tccataaata tctatttaaa ttataactaa ttatttcata 26220
tacttaattg atgacgtgga tgcattgcca tcgttgttta ataattgtta attacgacat 26280
gataaataaa atgaaagtaa aaagtacgaa agattttcca tttgttgttg tataaataga 26340
gaagtgagtg atgcataatg catgaatgca tgaccgcgcc accatgactg ttggatacga 26400
cgaggagatc ccattcgagc aagttagggc tcataacaag ccagacgacg cttggtgtgc 26460
tattcacgga cacgtgtacg acgttaccaa gttcgcttca gttcacccag gaggagatat 26520
tatcttgctc gctgctggaa aggaagctac tgtcctctac gagacctacc atgttagagg 26580
agtgtctgac gctgtgctca gaaagtacag aataggaaag ttgccagacg gacaaggagg 26640
agctaacgag aaggagaaga gaaccttgtc tggattgtcc tctgcttctt actacacctg 26700
gaactccgat ttctacagag tgatgaggga gagagttgtg gctagattga aggagagagg 26760

aaaggctaga agaggaggat acgaactctg gatcaaggct ttcttgctcc ttgttggatt 26820
ctggtcctct ctttactgga tgtgcaccct cgatccatct ttcggagcta tcttggctgc 26880
tatgtctttg ggagtgttcg ctgcttttgt tggaacctgc atccaacacg atggaaacca 26940
cggagctttc gctcaatcta gatgggttaa caaggtggca ggatggactt tggatatgat 27000
cggagcttct ggaatgactt gggagttcca acacgtgttg ggacaccacc catacactaa 27060
cttgatcgag gaggagaacg gattgcaaaa ggtgtccgga aagaagatgg ataccaagtt 27120
ggctgatcaa gagtctgatc cagatgtgtt ctccacctac ccaatgatga gattgcaccc 27180
ttggcaccag aagaggtggt atcacaggtt ccagcacatc tacggacctt tcatcttcgg 27240
attcatgacc atcaacaagg tggtgactca agatgttgga gtggtgttga gaaagagact 27300
cttccaaatc gatgctgagt gcagatatgc ttccccaatg tacgttgcta ggttctggat 27360
tatgaaggct ttgaccgtgt tgtatatggt tgctttgcct tgttatatgc aaggaccttg 27420
gcacggattg aaactcttcg ctatcgctca cttcacttgc ggagaggttt tggctaccat 27480
gttcatcgtg aaccacatta tcgagggagt gtcttacgct tctaaggatg ctgttaaggg 27540
aactatggct ccaccaaaga ctatgcacgg agtgacccca atgaacaaca ctagaaagga 27600
ggttgaggct gaggcttcta agtctggagc tgtggttaag tctgtgccat tggatgattg 27660
ggctgctgtt cagtgccaaa cctctgtgaa ctggtctgtt ggatcttggt tttggaacca 27720
cttctctgga ggactcaacc accaaatcga gcaccacctc ttcccaggat tgtctcacga 27780
gacctactac cacatccaag acgtggttca atctacctgt gctgagtacg gagttccata 27840
ccaacacgag ccatctttgt ggactgctta ctggaagatg ctcgaacacc ttagacaatt 27900
gggaaacgag gagactcacg agtcatggca gagagctgct tgattaatga actaagactc 27960
ccaaaaccac cttccctgtg acagttaaac cctgcttata cctttcctcc taataatgtt 28020
catctgtcac acaaactaaa ataaataaaa tgggagcaat aaataaaatg ggagctcata 28080
tatttacacc atttacactg tctattattc accatgccaa ttattacttc ataattttaa 28140
aattatgtca tttttaaaaa ttgcttaatg atggaaagga ttattataag ttaaaagtat 28200
aacatagata aactaaccac aaaacaaatc aatataaact aacttactct cccatctaat 28260
ttttatttaa atttctttac acttctcttc catttctatt tctacaacat tatttaacat 28320
ttttattgta tttttcttac tttctaactc tattcatttc aaaaatcaat atatgtttat 28380
caccacctct ctaaaaaaaa ctttacaatc attggtccag aaaagttaaa tcacgagatg 28440
gtcattttag cattaaaaca acgattcttg tatcactatt tttcagcatg tagtccattc 28500
tcttcaaaca aagacagcgg ctatataatc gttgtgttat attcagtcta aaacaactag 28560
ctagcctcag ctgacgttac gtaacgctag gtagcgtcac gtgacgttag ctaacgctag 28620
gtagcgtcag ctgagcttac gtaagcgcca cgggcaggac atagggacta ctacaagcat 28680
agtatgcttc agacaaagag ctaggaaaga actcttgatg gaggttaaga gaaaaaagtg 28740
ctagaggggc atagtaatca aacttgtcaa aaccgtcatc atgatgaggg atgacataat 28800
ataaaaagtt gactaaggtc ttggtagtac tctttgatta gtattatata ttggtgagaa 28860
catgagtcaa gaggagacaa gaaaccgagg aaccatagtt tagcaacaag atggaagttg 28920
caaagttgag ctagccgctc gattagttac atctcctaag cagtactaca aggaatggtc 28980
tctatacttt catgtttagc acatggtagt gcggattgac aagttagaaa cagtgcttag 29040
gagacaaaga gtcagtaaag gtattgaaag agtgaagttg atgctcgaca ggtcaggaga 29100
agtccctccg ccagatggtg actaccaagg ggttggtatc agctgagacc caaataagat 29160
tcttcggttg aaccagtggt tcgaccgaga ctcttagggt gggatttcac tgtaagattt 29220
gtgcattttg ttgaatataa attgacaatt ttttttattt aattatagat tatttagaat 29280
gaattacata tttagtttct aacaaggata gcaatggatg ggtatgggta caggttaaac 29340
atatctatta cccacccatc tagtcgtcgg gttttacacg tacccacccg tttacataaa 29400
ccagaccgga attttaaacc gtacccgtcc gttagcgggt ttcagattta cccgtttaat 29460
cgggtaaaac ctgattacta aatatatatt ttttatttga taaacaaaac aaaaatgtta 29520
atattttcat attggatgca attttaagaa acacatattc ataaatttcc atatttgtag 29580
gaaaataaaa agaaaaatat attcaagaac acaaatttca ccgacatgac ttttattaca 29640
gagttggaat tagatctaac aattgaaaaa ttaaaattaa gatagaatat gttgaggaac 29700
atgacatagt ataatgctgg gttacccgtc gggtaggtat cgaggcggat actactaaat 29760
ccatcccact cgctatccga taatcactgg tttcgggtat acccattccc gtcaacaggc 29820
ctttttaacc ggataatttc aacttatagt gaatgaattt tgaataaata gttagaatac 29880
caaaatcctg gattgcattt gcaatcaaat tttgtgaacc gttaaatttt gcatgtactt 29940
gggatagata taatagaacc gaattttcat tagtttaatt tataacttac tttgttcaaa 30000
gaaaaaaaat atctatccaa tttacttata ataaaaaata atctatccaa gttacttatt 30060
ataatcaact tgtaaaaagg taagaataca aatgtggtag cgtacgtgtg attatatgtg 30120
acgaaatgtt atatctaaca aaagtccaaa ttcccatggt aaaaaaaatc aaaatgcatg 30180
gcaggctgtt tgtaaccttg gaataagatg ttggccaatt ctggagccgc cacgtacgca 30240
agactcaggg ccacgttctc ttcatgcaag gatagtagaa caccactcca cccacctcct 30300
atattagacc tttgcccaac cctccccaac tttcccatcc catccacaaa gaaaccgaca 30360
tttttatcat aaatcagggt ttcgtttttg tttcatcgat aaactcaaag gtgatgattt 30420
tagggtcttg tgagtgtgct tttttgtttg attctactgt agggtttatg ttctttagct 30480
cataggtttt gtgtatttct tagaaatgtg gcttctttaa tctctgggtt tgtgactttt 30540
tgtgtggttt ctgtgttttt catatcaaaa acctattttt tccgagtttt tttttacaaa 30600
ttcttactct caagcttgaa tacttcacat gcagtgttct tttgtagatt ttagagttaa 30660
tgtgttaaaa agtttggatt tttcttgctt atagagcttc ttcactttga ttttgtgggt 30720
ttttttgttt taaaggtgag atttttgatg aggtttttgc ttcaaagatg tcacctttct 30780
gggtttgtct tttgaataaa gctatgaact gtcacatggc tgacgcaatt ttgttactat 30840

gtcatgaaag ctgacgtttt tccgtgttat acatgtttgc ttacacttgc atgcgtcaaa 30900
aaaattgggg ctttttagtt ttagtcaaag attttacttc tcttttggga tttatgaagg 30960
aaagttgcaa actttctcaa attttaccat ttttgctttg atgtttgttt agattgcgac 31020
agaacaaact catatatgtt gaaatttttg cttggttttg tataggattg tgtcttttgc 31080
ttataaatgt tgaaatctga acttttttttt tgtttggttt ctttgagcag gagataaggc 31140
gcaccaccat ggcttctaca tctgctgctc aagacgctgc tccttacgag ttcccttctc 31200
tcactgagat caagagggct cttccttctg agtgtttcga ggcttctgtt cctctttctc 31260
tctactacac cgctagatct cttgctcttg ctggatctct cgctgttgct ctctcttacg 31320
ctagagcttt gcctcttgtt caggctaacg ctcttcttga tgctactctc tgcactggat 31380
acgttcttct ccagggaatc gttttctggg gattcttcac cgttggtcac gattgtggac 31440
acggagcttt ctctagatct cacgtgctca acttctctgt tggaaccctc atgcactcta 31500
tcatccttac ccctttcgag tcttggaagc tctctcacag acaccaccac aagaacaccg 31560
gaaacatcga taaggacgag atcttctacc ctcaaagaga ggctgattct caccctgttt 31620
ctagacacct tgtgatgtct cttggatctg cttggttcgc ttacctttc gctggattcc 31680
ctcctagaac catgaaccac ttcaaccctt gggaggctat gtatgttaga agagtggctg 31740
ctgtgatcat ctctctcgga gttcttttcg ctttcgctgg actctactct tacctcacct 31800
tcgttcttgg attcaccact atggctatct actacttcgg acctctcttc atcttcgcta 31860
ccatgcttgt tgttaccact ttcctccacc acaacgatga ggagacacct tggtacgctg 31920
attctgagtg gacttacgtg aagggaaacc tctcttctgt ggacagatct tacggtgctc 31980
tcatcgacaa ccttagccac aacatcggaa ctcaccagat ccaccacctc ttccctatca 32040
tccctcacta caagctcaac gatgctactg ctgctttcgc taaggctttc cctgagcttg 32100
ttaggaaaaa cgctgctcct atcatcccaa ctttcttcag gatggctgct atgtacgcta 32160
agtacggagt tgttgacact gatgctaaga ccttcactct caaggaggct aaggctgctg 32220
ctaagactaa gtcatcttga tgattaatga aggccgcaga tatcagatct ggtcgaccta 32280
gaggatcccc ggccgcaaag ataataacaa aagcctacta tataacgtac atgcaagtat 32340
tgtatgatat taatgttttt acgtacgtgt aaacaaaaat aattacgttt gtaacgtatg 32400
gtgatgatgt ggtgcactag gtgtaggcct tgtattaata aaaagaagtt tgttctatat 32460
agagtggttt agtacgacga tttatttact agtcggattg gaatagagaa ccgaattctt 32520
caatccttgc ttttgatcaa gaattgaaac cgaatcaaat gtaaaagttg atatatttga 32580
aaaacgtatt gagcttatga aaatgctaat actctcatct gtatggaaaa gtgactttaa 32640
aaccgaactt aaaagtgaca aaaggggaat atcgcatcaa accgaatgaa accgatctac 32700
gtaggctcag ctgagcttac ctaaggctac gtaggctcac gtgacgttac gtaaggctac 32760
gtagcgtcac gtgagcttac ctaactctag ctagcctcac gtgaccttag ctaacactag 32820
gtagcgtcag cttagcagat atttggtgtc taaatgttta ttttgtgata tgttcatgtt 32880
tgaaatggtg gtttcgaaac cagggacaac gttgggatct gatagggtgt caaagagtat 32940
tatggattgg gacaatttcg gtcatgagtt gcaaattcaa gtatatcgtt cgattatgaa 33000
aattttcgaa gaatatccca tttgagagag tctttacctc attaatgttt ttagattatg 33060
aaattttatc atagttcatc gtagtctttt tggtgtaaag gctgtaaaaa gaaattgttc 33120
acttttgttt tcgtttatgt gaaggctgta aaagattgta aaagactatt ttggtgtttt 33180
ggataaaatg atagttttta tagattcttt tgcttttaga agaaatacat ttgaaatttt 33240
ttccatgttg agtataaaat accgaaatcg attgaagatc atagaaatat tttaactgaa 33300
aacaaattta taactgattc aattctctcc atttttatac ctatttaacc gtaatcgatt 33360
ctaatagatg atcgattttt tatataatcc taattaacca acggcatgta ttggataatt 33420
aaccgatcaa ctctcacccc taatagaatc agtattttcc ttcgacgtta attgatccta 33480
cactatgtag gtcatatcca tcgttttaat tttggccac cattcaattc tgtcttgcct 33540
ttagggatgt gaatatgaac ggccaaggta agagaataaa aataatccaa attaaagcaa 33600
gagaggccaa gtaagataat ccaaatgtac acttgtcatt gccaaaatta gtaaaatact 33660
cggcatattg tattcccaca cattattaaa ataccgtata tgtattggct gcatttgcat 33720
gaataatact acgtgtaagc ccaaaagaac ccacgtgtag cccatgcaaa gttaacactc 33780
acgaccccat tcctcagtct ccactatata aacccaccat ccccaatctc accaaaccca 33840
ccacacaact cacaactcac tctcacacct taaagaacca atcaccacca aaaaaagttc 33900
tttgctttcg aagttgccgc aacctaaaca ggtttttcct tcttctttct tcttattaac 33960
tacgaccttg tcctttgcct atgtaaaatt actaggtttt catcagttac actgattaag 34020
ttcgttatag tggaagataa aatgccctca aagcattttg caggatatct ttgatttttc 34080
aaagatatgg aactgtagag tttgatagtg ttcttgaatg tggttgcatg aagttttttt 34140
ggtctgcatg ttattttttc ctcgaaatat gttttgagtc caacaagtga ttcacttggg 34200
attcagaaag ttgttttctc aatatgtaac agttttttttc tatggagaaa aatcataggg 34260
accgttggtt ttggcttctt taattttgag ctcagattaa acccatttta cccggtgttc 34320
ttggcagaat tgaaaacagt acgtagtacc gcgcctacca tgccacctag tgctgctagt 34380
gaaggtggtg ttgctgaact tagagctgct gaagttgcta gctacactag aaaggctgtt 34440
gacgaaagac ctgacctcac tatagttggt gacgctgttt acgacgctaa ggcttttagg 34500
gacgagcacc ctggtggtgc tcacttcgtt agccttttcg gaggtaggga cgctactgag 34560
gcttttatgg aatatcaccg tagagcttgg cctaaggcta ggatgtctaa gttcttcgtt 34620
ggttcacttg acgctagcga gaagcctact caagctgatt cagcttacct tagactttgc 34680
gctgaggtta acgctctttt gcctaagggt agcggaggat tcgctcctcc tagctactgg 34740
cttaaggctg ctgctcttgt tgttgctgct gttagtatag agggttatat gctccttagg 34800
ggtaagaccc ttttgcttag cgttttcctt ggactcgtgt tcgcttggat aggacttaat 34860
attcagcacg acgctaatca cggtgctctt agtagacact cagtgattaa ctactgcctc 34920

ggttacgctc aggattggat aggtggtaat atggtgcttt ggcttcaaga gcacgttgtg 34980
atgcaccacc tccacactaa cgacgttgac gctgatcctg atcaaaaggc tcacggtgtt 35040
cttagactta agcctactga cggttggatg ccttggcacg cacttcaaca actctatatc 35100
cttcctggtg aggctatgta cgcttttaag cttcttttct tggacgccct tgagcttctt 35160
gcttggaggt gggagggtga gaagattagc cctcttgcta gagctttgtt cgctcctgct 35220
gttgcttgta agcttggatt ctgggctaga ttcgttgctc tccctctctg gcttcaacct 35280
actgttcaca ctgctttgtg tatctgtgct actgtgtgta ctggtagctt ctacctcgcc 35340
ttcttcttct ttatctctca caacttcgac ggtgttggta gcgttggacc taagggatca 35400
cttcctagat cagctacttt cgttcaacgt caggttgaga ctagctctaa cgttggtggt 35460
tactggcttg gagttcttaa cggtggactt aactttcaga tagagcacca cttgttccct 35520
aggcttcacc actcttacta cgctcaaata gctcctgtgg ttaggactca catagagaag 35580
ctcggtttta agtaccgtca cttccctacc gttggatcta accttagctc aatgcttcag 35640
catatgggta agatgggaac tagacctggt gctgagaagg gtggtaaggc tgagtagtga 35700
ttaatgaata attgattgct gctttaatga gatatgcgag acgcctatga tcgcatgata 35760
tttgctttca attctgttgt gcacgttgta aaaaacctga gcatgtgtag ctcagatcct 35820
taccgccggt ttcggttcat tctaatgaat atatcacccg ttactatcgt atttttatga 35880
ataatattct ccgttcaatt tactgattgt ctacgtagcg tcacctgacg ttacgtaagg 35940
ctacctaggc tcacgtgacg ttacgtaacg ctacgtagcg tcaggtgagg ttagctaacg 36000
ctagctagcc tcacctgacg ttaggtaagg ctacgtagcg tcacctgaga ttagctaagc 36060
ctacctagac tcacgtgacc ttaggtaacg ctacgtagcg tcaaagcttt acaacgctac 36120
acaaaactta taaccgtaat caccattcat taacttaact actatcacat gcattcatga 36180
attgaaacga gaaggatgta aatagttggg aagttatctc cacgttgaag agatcgttag 36240
cgagagctga aagaccgagg gaggagacgc cgtcaacacg gacagagtcg tcgaccctca 36300
catgaagtag gaggaatctc cgtgaggagc cagagagacg tctttggtct tcggtttcga 36360
tccttgatct gacggagaag acgagagaag tgcgactgga ctccgtgagg accaacagag 36420
tcgtcctcgg tttcgatcgt cggtattggt ggagaaggcg gaggaatctc cgtgacgagc 36480
cagagagatg tcgtcggtct tcggtttcga tccttgatct gacggagaag acgagagaag 36540
tgcgacgaga ctccgtgagg accaacagag ttgtcctcgg tttcgatcgt cggtttcggc 36600
ggagaaggcg gaggaatctc cgtgaggagc cagagagacg tcgttggtct tcggtttcga 36660
tccttgatct gttggagaag acgagacaag tgggacgaga ctcaacgacg gagtcagaga 36720
cgtcgtcggt cttcggtttc ggccgagaag gcggagtcgg tcttcggttt cggccgagaa 36780
ggcggaggag acgtcttcga tttgggtctc tcctcttgac gaagaaaaca aagaacacga 36840
gaaataatga gaaagagaac aaaagaaaaa aaaataaaaa taaaaataaa atttggtcct 36900
cttatgtggt gacacgtggt ttgaaaccca ccaaataatc gatcacaaaa aacctaagtt 36960
aaggatcggt aataaccttt ctaattaatt ttgatttata ttaaatcact ctttttattt 37020
ataaacccca ctaaattatg cgatattgat tgtctaagta caaaaattct ctcgaattca 37080
atacacatgt ttcatatatt tagccctgtt catttaatat tactagcgca tttttaattt 37140
aaaattttgt aaactttttt ggtcaaagaa catttttta attagagaca gaaatctaga 37200
ctctttattt ggaataatag taataaagat atattaggca atgagtttat gatgttatgt 37260
ttatatagtt tatttcattt taaattgaaa agcattattt ttatcgaaat gaatctagta 37320
tacaatcaat atttatgttt tttcatcaga tactttccta ttttttggca cctttcatcg 37380
gactactgat ttatttcaat gtgtatgcat gcatgagcat gagtatacac atgtctttta 37440
aaatgcatgt aaagcgtaac ggaccacaaa agaggatcca tacaaataca tctcatcgct 37500
tcctctacta ttctccgaca cacacactga gcatggtgct taaacactct ggtgagttct 37560
agtacttctg ctatgatcga tctcattacc atttcttaaa tttctctccc taaatattcc 37620
gagttcttga tttttgataa cttcaggttt tctcttttg ataaatctgg tctttccatt 37680
tttttttttt tgtggttaat ttagtttcct atgttcttcg attgtattat gcatgatctg 37740
tgtttggatt ctgttagatt atgtattggt gaatatgtat gtgtttttgc atgtctggtt 37800
ttggtcttaa aaatgttcaa atctgatgat ttgattgaag cttttttagt gttggtttga 37860
ttcttctcaa aactactgtt aatttactat catgttttcc aactttgatt catgatgaca 37920
cttttgttct gctttgttat aaaattttgg ttggtttgat tttgtaatta tagtgtaatt 37980
ttgttaggaa tgaacatgtt ttaatactct gttttcgatt tgtcacacat tcgaattatt 38040
aatcgataat ttaactgaaa attcatggtt ctagatcttg ttgtcatcag attatttgtt 38100
tcgataattc atcaaatatg tagtcctttt gctgatttgc gactgtttca ttttttctca 38160
aaattgtttt ttgttaagtt tatctaacag ttatcgttgt caaaagtctc tttcattttg 38220
caaaatcttc tttttttttt tgtttgtaac tttgtttttt aagctacaca tttagtctgt 38280
aaaatagcat cgaggaacag ttgtcttagt agacttgcat gttcttgtaa cttctatttg 38340
tttcagtttg ttgatgactg ctttgatttt gtaggtcaaa ccgcgccatg tctgctagcg 38400
gagctttgtt gcctgctata gctttcgctg cttacgctta cgctacctac gcttatgctt 38460
tcgagtggag ccacgctaac ggaatcgata acgtggatgc tagagagtgg attggagctt 38520
tgtctttgag actccctgca attgcaacca caatgtacct cttgttctgc cttgtgggac 38580
ctagattgat ggctaagagg gaggcttttg atcctaaggg atttatgctc gcttacaacg 38640
cttaccaaac cgctttcaac gttgtggtgc tcggaatgtt cgctagagag atctctggat 38700
tgggacaacc tgtttgggga tctactatgc cttggagcga taggaagtcc ttcaagattt 38760
tgttgggagt gtggctccac tacaacaata agtacctcga gttgttggat actgtgttca 38820
tggtggctag gaaaaagacc aagcagctct ctttcttgca cgtgtaccac cacgctttgt 38880
tgatttgggc ttggtggctt gtttgtcacc tcatggctac caacgattgc atcgatgctt 38940
atttcggagc tgcttgcaac tctttcatcc acatcgtgat gtactcctac tacctcatgt 39000

ctgctttggg aattaggtgc ccttggaaga gatatatcac ccaggctcag atgttgcaat 39060
tcgtgatcgt gttcgctcac gctgttttcg tgctcagaca aaagcactgc cctgttactt 39120
tgccttgggc acaaatgttc gtgatgacaa atatgttggt gctcttcgga aacttctacc 39180
tcaaggctta ctctaacaag tctaggggag atggagcttc ttctgttaag cctgctgaga 39240
ctactagagc accttctgtg agaagaacca ggtcaaggaa gatcgattga tagttaatga 39300
actaagtttg atgtatctga gtgccaacgt ttactttgtc tttcctttct tttattggtt 39360
atgattagat gtttactatg ttctctcttt ttcgttataa ataaagaagt tcaattcttc 39420
tatagtttca aacgcgattt taagcgtttc tatttaggtt tacatgattt cttttacaaa 39480
atcatcttta aaatacagta tatttttagt tttcataaaa tatttaaaga aatgaaagtt 39540
tataaacatt cactcctatt ctctaattaa ggatttgtaa aacaaaaatt ttgtaagcat 39600
atcgatttat gcgttttgtc ttaattagct cactaaataa taaataatag cttatgttgt 39660
gggactgttt aattacctaa cttagaacta aaatcaactc tttgtgctag ctagcctcag 39720
ctgacgttac gtaacgctag gtagcgtcac gtgacgttag ctaacgctag gtagcgtcag 39780
ctgagcttac gtaagcgctt aattaaagta ctgatatcgg taccaaatcg aatccaaaaa 39840
ttacggatat gaatataggc atatccgtat ccgaattatc cgtttgacag ctagcaacga 39900
ttgtacaatt gcttctttaa aaaaggaaga aagaaagaaa gaaaagaatc aacatcagcg 39960
ttaacaaacg gccccgttac ggcccaaacg gtcatataga gtaacggcgt taagcgttga 40020
aagactccta tcgaaatacg taaccgcaaa cgtgtcatag tcagatcccc tcttccttca 40080
ccgcctcaaa cacaaaaata atcttctaca gcctatatat acaacccccc cttctatctc 40140
tcctttctca caattcatca tctttctttc tctaccccca attttaagaa atcctctctt 40200
ctcctcttca ttttcaaggt aaatctctct ctctctctct ctctctgtta ttccttgttt 40260
taattaggta tgtattattg ctagtttgtt aatctgctta tcttatgtat gccttatgtg 40320
aatatcttta tcttgttcat ctcatccgtt tagaagctat aaatttgttg atttgactgt 40380
gtatctacac gtggttatgt ttatatctaa tcagatatga atttcttcat attgttgcgt 40440
ttgtgtgtac caatccgaaa tcgttgattt ttttcattta atcgtgtagc taattgtacg 40500
tatacatatg gatctacgta tcaattgttc atctgtttgt gtttgtatgt atacagatct 40560
gaaaacatca cttctctcat ctgattgtgt tgttacatac atagatatag atctgttata 40620
tcattttttt tattaattgt gtatatatat atgtgcatag atctggatta catgattgtg 40680
attatttaca tgattttgtt atttacgtat gtatatatgt agatctggac tttttggagt 40740
tgttgacttg attgtatttg tgtgtgtata tgtgtgttct gatcttgata tgttatgtat 40800
gtgcagctga accatggcgg cggcaacaac aacaacaaca acatcttctt cgatctcctt 40860
ctccaccaaa ccatctcctt cctcctccaa atcaccatta ccaatctcca gattctccct 40920
cccattctcc ctaaacccca acaaatcatc ctcctcctcc cgccgccgcg gtatcaaatc 40980
cagctctccc tcctccatct ccgccgtgct caacacaacc accaatgtca caaccactcc 41040
ctctccaacc aaacctacca aacccgaaac attcatctcc cgattcgctc cagatcaacc 41100
ccgcaaaggc gctgatatcc tcgtcgaggc tttagaacgt caaggcgtag aaaccgtatt 41160
cgcttaccct ggaggtacat caatggagat tcaccaagcc ttaacccgct cttcctcaat 41220
ccgtaacgtc cttcctcgtc acgaacaagg aggtgtattc gcagcagaag gatacgctcg 41280
atcctcaggt aaaccaggta tctgtatagc cacttcaggt cccggagcta caaatctcgt 41340
tagcggatta gccgatgcgt tgttagatag tgttcctctt gtagcaatca caggacaagt 41400
ccctcgtcgt atgattggta cagatgcgtt tcaagagact ccgattgttg aggtaacgcg 41460
ttcgattacg aagcataact atcttgtgat ggatgttgaa gatatcccaa ggattattga 41520
agaggctttc tttttagcta cttctggtag acctggacct gttttggttg atgttcctaa 41580
agatattcaa caacagcttg cgattcctaa ttgggaacag gctatgagat tacctggtta 41640
tatgtctagg atgcctaaac ctccggaaga ttctcatttg gagcagattg ttaggttgat 41700
ttctgagtct aagaagcctg tgttgtatgt tggtggtggt tgtcttaatt ctagcgatga 41760
attgggtagg tttgttgagc ttacgggcat ccctgttgcg agtacgttga tggggctggg 41820
atcttatcct tgtgatgatg agttgtcgtt acatatgctt ggaatgcatg ggactgtgta 41880
tgcaaattac gctgtggagc atagtgattt gttgttggcg tttggggtaa ggtttgatga 41940
tcgtgtcacg ggtaaacttg aggcttttgc tagtagggct aagattgttc atattgatat 42000
tgactcggct gagattggga agaataagac tcctcatgtg tctgtgtgtg gtgatgttaa 42060
gctggctttg caagggatga ataaggttct tgagaaccga gcggaggagc ttaaacttga 42120
ttttggagtt tggaggaatg agttgaacgt acagaaacag aagtttccgt tgagctttaa 42180
gacgtttggg gaagctattc ctccacagta tgcgattaag gtccttgatg agttgactga 42240
tggaaaagcc ataataagta ctggtgtcgg gcaacatcaa atgtgggcgg cgcagttcta 42300
caattacaag aaaccaaggc agtggctatc atcaggaggc cttggagcta tgggatttgg 42360
acttcctgct gcgattggag cgtctgttgc taaccctgat gcgatagttg tggatattga 42420
cggagatgga agttttataa tgaatgtgca agagctagcc actattcgtg tagagaatct 42480
tccagtgaag gtacttttat taaacaacca gcatcttggc atggttatgc aatgggaaga 42540
tcggttctac aaagctaacc gagctcacac atttctcggg gacccggctc aggaggacga 42600
gatattcccg aacatgttgc tgtttgcagc agcttgcggg attccagcgg cgagggtgac 42660
aaagaaagca gatctccgag aagctattca gacaatgctg gatacaccag gaccttacct 42720
gttggatgtg atttgtccgc accaagaaca tgtgttgccg atgatcccga atggtggcac 42780
tttcaacgat gtcataacgg aaggagatgg ccggattaaa tactgagaga tgaaaccggt 42840
gattatcaga accttttatg gtctttgtat gcatatggta aaaaaactta gtttgcaatt 42900
tcctgtttgt tttggtaatt tgagtttctt ttagttgttg atctgcctgc tttttggttt 42960
acgtcagact actactgctg ttgttgtttg gtttcctttc tttcatttta taaataaata 43020
atccggttcg gtttactcct tgtgactggc tcagtttggt tattgcgaaa tgcgaatggt 43080

aaattgagta attgaaattc gttattaggg ttctaagctg ttttaacagt cactgggtta 43140
atatctctcg aatcttgcat ggaaaatgct cttaccattg gtttttaatt gaaatgtgct 43200
catatgggcc gtggtttcca aattaaataa aactacgatg tcatcgagaa gtaaaatcaa 43260
ctgtgtccac attatcagtt ttgtgtatac gatgaaatag ggtaattcaa aatctagctt 43320
gatatgcctt ttggttcatt ttaaccttct gtaaacattt tttcagattt tgaacaagta 43380
aatccaaaaa aaaaaaaaaa aatctcaact caacactaaa ttattttaat gtataaaaga 43440
tgcttaaaac atttggctta aaagaaagaa gctaaaaaca tagagaactc ttgtaaattg 43500
aagtatgaaa atatactgaa ttgggtatta tatgaatttt tctgatttag gattcacatg 43560
atccaaaaag gaaatccaga agcactaatc agacattgga agtaggatta atcagtgatc 43620
agtaactatt aaattcaatt aaccgcggac atctacattt ttgaattgaa aaaaaattgg 43680
taattactct ttcttttttct ccatattgac catcatactc attgctgatc catgtagatt 43740
tcccggacat gaagccattt acaattgaat atatcctgcc gccgctgccg ctttgcaccc 43800
ggtggagctt gcatgttggt ttctacgcag aactgagccg gttaggcaga taatttccat 43860
tgagaactga gccatgtgca ccttcccccc aacacggtga gcgacggggc aacggagtga 43920
tccacatggg acttttaaac atcatccgtc ggatggcgtt gcgagagaag cagtcgatcc 43980
gtgagatcag tcgaccaatt ctcatgtttg acagcttatc atcgaatttc tgccattcat 44040
ccgcttatta tcacttattc aggcgtagca accaggcgtt taagggcacc aataactgcc 44100
ttaaaaaaat tacgccccgc cctgccactc atcgcagtac tgttgtaatt cattaagcat 44160
tctgccgaca tggaagccat cacaaacggc atgatgaacc tgaatcgcca gcggcatcag 44220
caccttgtcg ccttgcgtat aatatttgcc catggtgaaa acgggggcga agaagttgtc 44280
catattggcc acgtttaaat caaaactggt gaaactcacc cagggattgg ctgagacgaa 44340
aaacatattc tcaataaacc ctttagggaa ataggccagg ttttcaccgt aacacgccac 44400
atcttgcgaa tatatgtgta gaaactgccg gaaatcgtcg tggtattcac tccagagcga 44460
tgaaaacgtt tcagtttgct catggaaaac ggtgtaacaa gggtgaacac tatcccatat 44520
caccagctca ccgtctttca ttgccatacg gaattccgga tgagcattca tcaggcgggc 44580
aagaatgtga ataaaggccg gataaaactt gtgcttattt ttctttacgg tctttaaaaa 44640
ggccgtaata tccaggacct gcaggggggg gggggcgctg aggtctgcct cgtgaagaag 44700
gtgttgctga ctcataccag gcctgaatcg ccccatcatc cagccagaaa gtgagggagc 44760
cacggttgat gagagctttg ttgtaggtgg accagttggt gattttgaac ttttgctttg 44820
ccacggaacg gtctgcgttg tcgggaagat gcgtgatctg atccttcaac tcagcaaaag 44880
ttcgatttat tcaacaaagc cgccgtcccg tcaagtcagc gtaatgctct gccagtgtta 44940
caaccaatta accaattctg attagaaaaa ctcatcgagc atcaaatgaa actgcaattt 45000
attcatatca ggattatcaa taccatattt ttgaaaaagc cgtttctgta atgaaggaga 45060
aaactcaccg aggcagttcc ataggatggc aagatcctgg tatcggtctg cgattccgac 45120
tcgtccaaca tcaatacaac ctattaattt cccctcgtca aaaataaggt tatcaagtga 45180
gaaatcacca tgagtgacga ctgaatccgg tgagaatggc aaaagcttat gcatttcttt 45240
ccagacttgt tcaacaggcc agccattacg ctcgtcatca aaatcactcg catcaaccaa 45300
accgttattc attcgtgatt gcgcctgagc gagacgaaat acgcgatcgc tgttaaaagg 45360
acaattacaa acaggaatcg aatgcaaccg gcgcaggaac actgccagcg catcaacaat 45420
attttcacct gaatcaggat attcttctaa tacctggaat gctgttttcc cggggatcgc 45480
agtggtgagt aaccatgcat catcaggagt acggataaaa tgcttgatgg tcggaagagg 45540
cataaattcc gtcagccagt ttagtctgac catctcatct gtaacatcat tggcaacgct 45600
acctttgcca tgtttcagaa acaactctgg cgcatcgggc ttcccataca atcgatagat 45660
tgtcgcacct gattgcccga cattatcgcg agcccattta tacccatata aatcagcatc 45720
catgttggaa tttaatcgcg gcctcgagca agacgtttcc cgttgaatat ggctcataac 45780
accccttgta ttactgttta tgtaagcaga cagttttatt gttcatgatg atatattttt 45840
atcttgtgca atgtaacatc agagattttg agacacaacg tggctttccc cccccccccct 45900
gcaggtcctg aacggtctgg ttataggtac attgagcaac tgactgaaat gcctcaaaat 45960
gttctttacg atgccattgg gatatatcaa cggtggtata tccagtgatt tttttctcca 46020
ttttagcttc cttagctcct gaaaatctcg ataactcaaa aaatacgccc ggtagtgatc 46080
ttatttcatt atggtgaaag ttggaacctc ttacgtgccg atcaacgtct cattttcgcc 46140
aaaagttggc ccagggcttc ccggtatcaa cagggacacc aggatttatt tattctgcga 46200
agtgatcttc cgtcacaggt atttattcgc gataagctca tggagcggcg taaccgtcgc 46260
acaggaagga cagagaaagc gcggatctgg gaagtgacgg acagaacggt caggacctgg 46320
attggggagg cggttgccgc cgctgctgct gacggtgtga cgttctctgt tccggtcaca 46380
ccacatacgt tccgccattc ctatgcgatg cacatgctgt atgccggtat accgctgaaa 46440
gttctgcaaa gcctgatggg acataagtcc atcagttcaa cggaagtcta cacgaaggtt 46500
tttgcgctgg atgtggctgc ccggcaccgg gtgcagtttg cgatgccgga gtctgatgcg 46560
gttgcgatgc tgaaacaatt atcctgagaa taaatgcctt ggcctttata tggaaatgtg 46620
gaactgagtg gatatgctgt ttttgtctgt taaacagaga agctggctgt tatccactga 46680
gaagcgaacg aaacagtcgg gaaaatctcc cattatcgta gagatccgca ttattaatct 46740
caggagcctg tgtagcgttt ataggaagta gtgttctgtc atgatgcctg caagcggtaa 46800
cgaaaacgat ttgaatatgc cttcaggaac aatagaaatc ttcgtgcggt gttacgttga 46860
agtggagcgg attatgtcag caatggacag aacaacctaa tgaacacaga accatgatgt 46920
ggtctgtcct tttacagcca gtagtgctcg ccgcagtcga gcgacagggc gaagccctcg 46980
agtgagcgag gaagcaccag ggaacagcac ttatatattc tgcttacaca cgatgcctga 47040
aaaaacttcc cttggggtta tccacttatc cacggggata tttttataat tatttttttt 47100
atagttttta gatcttcttt tttagagcgc cttgtaggcc tttatccatg ctggttctag 47160

agaaggtgtt gtgacaaatt gccctttcag tgtgacaaat caccctcaaa tgacagtcct 47220
gtctgtgaca aattgccctt aaccctgtga caaattgccc tcagaagaag ctgtttttc 47280
acaaagttat ccctgcttat tgactctttt ttatttagtg tgacaatcta aaaacttgtc 47340
acacttcaca tggatctgtc atggcggaaa cagcggttat caatcacaag aaacgtaaaa 47400
atagcccgcg aatcgtccag tcaaacgacc tcactgaggc ggcatatagt ctctcccggg 47460
atcaaaaacg tatgctgtat ctgttcgttg accagatcag aaaatctgat ggcaccctac 47520
aggaacatga cggtatctgc gagatccatg ttgctaaata tgctgaaata ttcggattga 47580
cctctgcgga agccagtaag gatatacggc aggcattgaa gagtttcgcg gggaaggaag 47640
tggtttttta tcgccctgaa gaggatgccg gcgatgaaaa aggctatgaa tcttttcctt 47700
ggtttatcaa acgtgcgcac agtccatcca gagggcttta cagtgtacat atcaacccat 47760
atctcattcc cttctttatc gggttacaga accggtttac gcagtttcgg cttagtgaaa 47820
caaaagaaat caccaatccg tatgccatgc gtttatacga atccctgtgt cagtatcgta 47880
agccggatgg ctcaggcatc gtctctctga aaatcgactg gatcatagag cgttaccagc 47940
tgcctcaaag ttaccagcgt atgcctgact tccgccgccg cttcctgcag gtctgtgtta 48000
atgagatcaa cagcagaact ccaatgcgcc tctcatacat tgagaaaaag aaaggccgcc 48060
agacgactca tatcgtattt tccttccgcg atatcacttc catgacgaca ggatagtctg 48120
agggttatct gtcacagatt tgagggtggt tcgtcacatt tgttctgacc tactgagggt 48180
aatttgtcac agttttgctg tttccttcag cctgcatgga ttttctcata ctttttgaac 48240
tgtaattttt aaggaagcca aatttgaggg cagtttgtca cagttgattt ccttctcttt 48300
cccttcgtca tgtgacctga tatcgggggt tagttcgtca tcattgatga gggttgatta 48360
tcacagttta ttactctgaa ttggctatcc gcgtgtgtac ctctacctgg agtttttccc 48420
acggtggata tttcttcttg cgctgagcgt aagagctatc tgacagaaca gttcttcttt 48480
gcttcctcgc cagttcgctc gctatgctcg gttacacggc tgcggcgagc gctagtgata 48540
ataagtgact gaggtatgtg ctcttcttat ctccttttgt agtgttgctc ttattttaaa 48600
caactttgcg gtttttttgat gactttgcga ttttgttgtt gctttgcagt aaattgcaag 48660
atttaataaa aaaacgcaaa gcaatgatta aaggatgttc agaatgaaac tcatggaaac 48720
acttaaccag tgcataaacg ctggtcatga aatgacgaag gctatcgcca ttgcacagtt 48780
taatgatgac agcccggaag cgaggaaaat aacccggcgc tggagaatag gtgaagcagc 48840
ggatttagtt ggggtttctt ctcaggctat cagagatgcc gagaaagcag ggcgactacc 48900
gcacccggat atggaaattc gaggacgggt tgagcaacgt gttggttata caattgaaca 48960
aattaatcat atgcgtgatg tgtttggtac gcgattgcga cgtgctgaag acgtatttcc 49020
accggtgatc ggggttgctg cccataaagg tggcgtttac aaaacctcag tttctgttca 49080
tcttgctcag gatctggctc tgaaggggct acgtgttttg ctcgtggaag gtaacgaccc 49140
ccagggaaca gcctcaatgt atcacggatg ggtaccagat cttcatattc atgcagaaga 49200
cactctcctg cctttctatc ttggggaaaa ggacgatgtc acttatgcaa taaagcccac 49260
ttgctggccg gggcttgaca ttattccttc ctgtctggct ctgcaccgta ttgaaactga 49320
gttaatgggc aaatttgatg aaggtaaact gcccaccgat ccacacctga tgctccgact 49380
ggccattgaa actgttgctc atgactatga tgtcatagtt attgacagcg cgcctaacct 49440
gggtatcggc acgattaatg tcgtatgtgc tgctgatgtg ctgattgttc ccacgcctgc 49500
tgagttgttt gactacacct ccgcactgca gtttttcgat atgcttcgtg atctgctcaa 49560
gaacgttgat cttaaagggt tcgagcctga tgtacgtatt ttgcttacca aatacagcaa 49620
tagtaatggc tctcagtccc cgtggatgga ggagcaaatt cgggatgcct ggggaagcat 49680
ggttctaaaa aatgttgtac gtgaaacgga tgaagttggt aaaggtcaga tccggatgag 49740
aactgttttt gaacaggcca ttgatcaacg ctcttcaact ggtgcctgga gaaatgctct 49800
ttctatttgg gaacctgtct gcaatgaaat tttcgatcgt ctgattaaac cacgctggga 49860
gattagataa tgaagcgtgc gcctgttatt ccaaaacata cgctcaatac tcaaccggtt 49920
gaagatactt cgttatcgac accagctgcc ccgatggtgg attcgttaat tgcgcgcgta 49980
ggagtaatgg ctcgcggtaa tgccattact ttgcctgtat gtggtcggga tgtgaagttt 50040
actcttgaag tgctccgggg tgatagtgtt gagaagacct ctcgggtatg gtcaggtaat 50100
gaacgtgacc aggagctgct tactgaggac gcactggatg atctcatccc ttcttttcta 50160
ctgactggtc aacagacacc ggcgttcggt cgaagagtat ctggtgtcat agaaattgcc 50220
gatgggagtc gccgtcgtaa agctgctgca cttaccgaaa gtgattatcg tgttctggtt 50280
ggcgagctgg atgatgagca gatggctgca ttatccagat tgggtaacga ttatcgccca 50340
acaagtgctt atgaacgtgg tcagcgttat gcaagccgat tgcagaatga atttgctgga 50400
aatatttctg cgctggctga tgcggaaaat atttcacgta agattattac ccgctgtatc 50460
aacaccgcca aattgcctaa atcagttgtt gctctttttt ctcaccccgg tgaactatct 50520
gcccggtcag gtgatgcact tcaaaaagcc tttacagata aagaggaatt acttaagcag 50580
caggcatcta accttcatga gcagaaaaaa gctggggtga tatttgaagc tgaagaagtt 50640
atcactcttt taacttctgt gcttaaaacg tcatctgcat caagaactag tttaagctca 50700
cgacatcagt ttgctcctgg agcgacagta ttgtataagg gcgataaaat ggtgcttaac 50760
ctggacaggt ctcgtgttcc aactgagtgt atagagaaaa ttgaggccat tcttaaggaa 50820
cttgaaaagc cagcaccctg atgcgaccac gttttagtct acgtttatct gtctttactt 50880
aatgtccttt gttacaggcc agaaagcata actggcctga atattctctc tgggcccact 50940
gttccacttg tatcgtcggt ctgataatca gactgggacc acggtcccac tcgtatcgtc 51000
ggtctgatta ttagtctggg accacggtcc cactcgtatc gtcggtctga ttattagtct 51060
gggaccacgg tcccactcgt atcgtcggtc tgataatcag actgggacca cggtcccact 51120
cgtatcgtcg gtctgattat tagtctggga ccatggtccc actcgtatcg tcggtctgat 51180
tattagtctg ggaccacggt cccactcgta tcgtcggtct gattattagt ctggaaccac 51240

ggtcccactc gtatcgtcgg tctgattatt agtctgggac cacggtccca ctcgtatcgt 51300
cggtctgatt attagtctgg gaccacgatc ccactcgtgt tgtcggtctg attatcggtc 51360
tgggaccacg gtcccacttg tattgtcgat cagactatca gcgtgagact acgattccat 51420
caatgcctgt caagggcaag tattgacatg tcgtcgtaac ctgtagaacg gagtaacctc 51480
ggtgtgcggt tgtatgcctg ctgtggattg ctgctgtgtc ctgcttatcc acaacatttt 51540
gcgcacggtt atgtggacaa aatacctggt tacccaggcc gtgccggcac gtttcctaca 51600
aggtagaatc cgcctgagtc gcaagggtga cttcgcctat attggacgac ggcgcgcaga 51660
gggcgacctc tttttgggtt acgattgtag gattatcact aaaacaatac atgaacatat 51720
tcaaatggca atctctctaa ggcattggaa ataaatacaa ataacagttg ggtggagttt 51780
ttcgacctga gggcgttaac tcttcaagga caacaagacc gtggacgtcg agcggctctc 51840
cgacaagcat gtcgcccgcc tggtcaagca gaccgcactc gccgccggcg cttcgatacc 51900
gttcgtattg gtccggcgaa actgtgagta tccgcatcgt aatctccgca tgaacaggtc 51960
atgcgaacag aaatcatctc acggtgcgtt tgcctacgtg cagatttgca cctcaggtga 52020
ttctaccgag tcggtgttcc aaggcgcgaa atgcgagcgg gtgaggccga ccagacgccg 52080
acaaggttgt gcagatctgc acttggtgcc acgtcgcaca gaagaaggga atcggtctaa 52140
ctcacagata gcatttgaag aatcgggatt tagtgtgatt tcgattgaaa cgcgcgtaac 52200
cgttcattaa ccaaaaacgt cttgcaacct cacccgcatt aggtaatcgt cacggataaa 52260
tggcaatacg cgccaattaa ccgtgacaag agataacacc gtgagcaaag ccgctgccat 52320
atcccgaaat gatcgcccgt cggtagatgt taccattggt gagcatgctg agcagctcag 52380
ctctcagctt caagcgatga gcgaggcttt gtttcctccg acgtcgcaca agagcttgcg 52440
caaattcacc tcgggtgaag ccgcacgctt gatgaaaata tctgactcaa ctcttcgaaa 52500
gatgacactg gctggcgaag ggccgcaacc tgaactcgcc agcaacggac ggcgctttta 52560
caccctcggt cagataaacg aaatccggca gatgcttgcc ggctcgactc gaggacgtga 52620
aagcattgat tttgtgcctc atcgccgagg ttctgagcat ttgcaagtcg ttgctgtaac 52680
caacttcaaa ggtggctctg ggaagacgac gacgtccgct catcttgcac agtatctggc 52740
gttgcaaggt tacagggttc tcgcagtcga tctcgatccg caggctagtc tttcagcact 52800
cctcggcgtt ctgccagaaa ctgatgtcgg tgcaaacgaa acgctctatg cggctattcg 52860
gtacgacgac acacgtcgtc cgttgcgaga tgtgatccga ccgacgtatt ttgatggtct 52920
tcaccttgtt cctggaaatc tcgagcttat ggagttcgag cataccaccc cgaaagcatt 52980
gactgacaaa ggtacgcgcg acggattgtt cttcactcgc gtggcccaag cctttgatga 53040
ggtcgccgac gattacgatg tcgtggtcat cgactgccct cctcagcttg ggtttttgac 53100
tctcagcggg ttgtgtgctg caacatcaat ggtaatcacc gtacatcctc agatgctgga 53160
tatcgcttcc atgagccagt ttctcctcat gacacgcgac cttctgggtg tcgtgaaaga 53220
ggcggggggc aatctccagt acgatttcat acgctatctc ttgacgcgct atgagcccca 53280
ggacgcgccg cagacgaaag tgacggcact gctgcgcaac atgttcgagg atcacgtcct 53340
tacaaatcct atggtcaagt cggcagcggt atctgatgcc ggtttaacca agcagacgct 53400
ctatgagata gggcgagaga accttacgcg atcgacatac gaccgggcga tggaatcttt 53460
agatgcggtg aattcggaga tcgaggcttt gatcaagatg gcgtgggggc gggtctaatg 53520
aaaggctttg cgttcctcac agatctgttg ggagctccca acagacaggt gttgattcgc 53580
cccctggaca tggggcactg gagaagccgg ggtaatttga gacgacgacg cacgcccatc 53640
gctaattggc cagggtgcag ttgtcttgtc ttgttgggag ctcccaacca agcgcatttg 53700
caatcaaaaa tgcgacgcca cgacgccaaa cccaagaggc cgatatcatg agccgcaaag 53760
acgcaatcga tactttgttc ctcaagaagc aacctgcgac cgatagagca gcagtcgaca 53820
agtcgaccgc tcgtgttcgt accggagcga tttcggccat gggttcgtct ttgcaagaga 53880
tggctgaggg cgcaaaggct gcagctcggc tgcaggatca actggctaca ggcgaagccg 53940
tcgtgtccct ggatccatcc atgatcgacg ggtcgccgat cgcggatcgg ctgccctcag 54000
acgtggatcc gaaattcgag cagcttgagg cgagcatttc gcaggagggg cagcaggtgc 54060
cggttcttgt cagaccgcac cctgaggctg ccggtcgata tcagatcgta tatggaaggc 54120
ggcggctgcg cgcggcagta aatctgcgga gagaggtttc tgccattgtt cgaaatctca 54180
cggactgtga actggtcgtg gcccagggcc gcgaaaatct taaccgcgct gacctctcgt 54240
tcattgagaa ggctctcttc gccctgcgcc tcgaagatgc gggttttgat agagccacca 54300
tcattgccgc gctatccact gacaaggccg acctcagccg ctacataact gtagcaaggg 54360
gcataccgct gaacctcgcc acacaaatcg gcccagcgtc gaaagcgggt cgatcgcgtt 54420
gggtcgtact tgccgagggg cttgggaagc ctaaggcaac ggacgcaatc gaagcgatgc 54480
ttgggtcaga gcagttcaag caatctgata gcgatacccg ctttaacctc attttcaacg 54540
ccgtttcaag gccacctgcg aagactccaa aaaaggtaag ggcctggagc acgccaaagg 54600
ggaaaaaggc agcgacgatc cgacaagaaa ctggacgaac ggcgctggtt ttcgacgaga 54660
gactggtgcc aacttttggc gaatatgtcg ctgaccagtt ggacagtctg tacgcccagt 54720
tcattgaaac caacggagga ggcaagctcg accaatagtc agggtttcat ccaatttaaa 54780
gctccgctcg actgagatgg actggctctc accgcaaaag aaaaaggccc ccgaaacggc 54840
gttccggaag accttctctg tagtctcgca gctaagagaa tcgcatttcc aggaatcgta 54900
gtcaagggtc ccgtaaggga aagcgtcatt tcgacgggcg gatttcaatt gcctaacaaa 54960
aggtaaaagg aaatgcagac gcatatctca acgacgtcct ttgggcggcg gccgatgaca 55020
ctcggccata ttgcaagcca gatggcagca aaagcggtcg catcagacac tgtcgcccac 55080
aaatggcagg tcttccagca catccgtgaa tcccggggac tgatcggagc cacggaccgc 55140
tcactctcga tcctgaacgc gctgttgacg ttttacccgg agaccgcctt gactggtggt 55200
gccgaactgg tcgtatggcc ttctaacgaa cagctgatgg ctcgcgccaa cggcatgccc 55260
gccacgacac tgcgccggca tcttgccata ctggttgatt gcgggctcat cattcgccgc 55320

gacagcccca atggcaagcg gttcgcccgc aagggaaggg gaggggagat tgagcaggcc 55380
tatgggttcg atctgtcgcc gatcgtcgcg cgggccgagg agttccgaga tctggcccag 55440
acagtgcaag ctgaaaaaaa ggccttccgg gtggccaagg agcgcttgac tcttcttcgt 55500
cgtgacattg tcaaaatgat cgaaactggc gtcgaagaga gcgttcctgg aaactgggga 55560
agagttaccc agacctatca ggggatcatc ggccgcctgc cacgctcggc acctcggcag 55620
cttgtcgaga gtattgggca agagcttcag gaactctgca tcgagatccg tgacgtattg 55680
gaatctttca caaaaacgat gaatctggac gccaatgagt cccatatcgg tcgccacaaa 55740
cagaattcaa atccagactc taaatttgaa tctgaataca gctctggaaa aaaagatgaa 55800
gcgggcggca gcgttgcgga aaccgacaat gtacggagct tgccgaaacg cgagctgcct 55860
ttgggaatcg tgctggatgc ctgcccccgaa atgcgggaat tggcccaggg aggtccaatt 55920
cggcattggc gcgacttgct ggcggcggct gagcttgccc ggccgatgct ggggattagt 55980
ccgagcgcct ggcgggaggc ccgcgaaacc atgggcgatc aacacgcggc gatcacgctg 56040
gcttcgatct atcagcgggc cggtcagatc aataacgctg ggggctatct gcgcagcctg 56100
accgaccggg ccaaggatgg gaagttttcg acctggccga tggtcatggc gttgctccgg 56160
gcaaagctgg acgagcagaa gaatgcagtt ggcgctggaa agccgcgaac tgctgaggag 56220
gtcgaggatg acagccgcct ccacgtatcg gaatcgctgc tcaaaaacct gcgaaagccg 56280
agatcttggt gatcctctcg ctattcagcc gcggcgatgt cgacgtcggt gatcaacccg 56340
gaacgtcggg cgcggtcgat caggttcttg acggacgagg gcgcccattt ggatccaccg 56400
cgcggcgtgc gctcgtgcag tctttcaagc tggccggcga tctcgcggag cttcaggtct 56460
gggttcgaag aatggatgcc ggccacaagc gtcatcaggc gatcttcggg aagacgggga 56520
ggagattttt tcaggagcgc tgcatccacc aggcgttccg tcaccatcca cttcacggct 56580
cggcgaagac gttctggcgt ccagtcgagg ccccgctgct tgagcattcg ggcgatgtcg 56640
tcccatgtgt gatccggtcg catgcgacga acggtaggaa gccattggtt cgcggacgcc 56700
tgaatcctat cgccatatgc cgctttctgg gccgcggtca tccttgccag cgcctccggg 56760
cgcttttccc ggatgcccgg gttgccggaa agcttcccta ggcacaaacg ttgactcttg 56820
gatcgagctg gcagacaaag caataaccca cacagaggac gattaatggc tgacgaagag 56880
atccagaatc cgccggacgg tactgctgct gccgaagttg agccggctgc tcctagaggt 56940
agaagagcaa agaaagcacc agccgaaaca gcccgcacgg gatcgttcaa atccgtgaag 57000
ccgaaaaccc gcggcctcag caaccgagaa aaactggaga agatcggtca aatcgaagct 57060
caggtcgctg gcggcgcaac cttgaaggac gccgttaaga tcgtgggtat ttccgttcag 57120
acctattatc aatggaagag agctgcggtt caacctgtct cacagaatcc ggccgtgtct 57180
gtttcagttg acgatgaact cggcgagttc atccaactcg aggaggaaaa tcggcggctc 57240
agaaagcttc acgctgccgc aagcactcag ggcgcaaggg ctgctaaagg aagcggaaca 57300
cgtagaaagc cagtccgcag aaacggtgct gaccccggat gaatgtcagc tactgggcta 57360
tctggacaag ggaaaacgca agcgcaaaga gaaagcaggt agcttgcagt gggcttacat 57420
ggcgatagct agactgggcg gttttatgga cagcaagcga accggaattg ccagctgggg 57480
cgccctctgg gaaggttggg aagccctgca aagtaaactg gatggctttc ttgccgccaa 57540
ggatctgatg gcgcagggga tcaagatctg atcaagagac aggggccggc ccacgctgtc 57600
gtccaatctc ccaagacacg ccgccaccgc gcaccgtcgc ggcgagctgc tccccaagcc 57660
gctgttcgat gggcttccac cgcacgaggc tggacccctt ggcgtcatca agcatcccat 57720
ttcgcccgct ggcgagcatg acggggcgcc ggtagacgcc ggcaacgcgc tggccgtcgg 57780
ccacggggcg atgctccagg ccggtatcgg cggcaatgtc cttcgcggcc tgcgccagtt 57840
cccgagcccg ctgctgccca gcagattccg gtgaggatca cgcgctgccc gcgccgctcg 57900
gccagtccct gttcggccag gaagtccgcg cgctgctgta tcgcctactt ggcctcactg 57960
ctaaagccca ggtcgcccaa gcccgagcca ccgtcgatca actgctggtc aagccaggtg 58020
gcaccgatca cgcgggcctg ccgctcgatg ggcaggtgcg atttcagctc caccgtcacg 58080
ccaccaagac gctgggcgtc atagcggcgg ccctgctcgg gcagatcgtc cggcaccttc 58140
catagtccct cggccacgca caccacgatg ccggcctggt gcagggcttc gaggcggcgg 58200
gtgtggcccg caacgacttc cagcggatca cgcccgacac ggcctgacct agctcgacga 58260
ccaggtgaga tcggtgaccg cgctagtcaa gcaaccggcg tgccatggcg tttacggcca 58320
gatcaatcgc agcgccctcg ccctcgccgt cgccgtcgcc gatgaaccag gctgccgaca 58380
agcccgtcca tgcaatgatc cagcgaagaa gccgttcggg ctcaaacccg gtcgtcgcga 58440
ccacaatgct gagtcgagcc tccagcctgc ccggcaggat cgcaagcggg cgaccggggt 58500
cgctgagatc gggattcgtg aagatgttgg catagtcgaa ggtgcgctcg ccgagcagtc 58560
cgtgcgggtc gatggccagc cagccgcggt cgccgaagtc gagcacgttc tcgtggtgca 58620
ggtcgccgtg gagcgggcac acctcgcgcg gcgccgccag aagttggcgc gctacgctgg 58680
cggcgggcgc aagtgccgcg tgctcagcgg ccaaccggaa aagcggctgg aaccattcct 58740
gtagcggatg gagatcgggc ggcggtccgg accgcggcgc gtgcagacga gcggcggtgt 58800
cgcagaggat cgtggcatca ccgaaccgcg ccgtgcgcgg gtcgtcggtg agccagagtt 58860
tcagcaggcc gcccaggcgg cccaggtcgc cattgatgcg ggccagctcg cggacgtgct 58920
catagtccac gacgcccgtg attttgtagc cctggccgac ggccagcagg taggccgaca 58980
ggctcatgcc ggccgccgcc gccttttcct caatcgctct tcgttcgtct ggaaggcagt 59040
acaccttgat aggtgggctg cccttcctgg ttggcttggt ttcatcagcc atccgcttgc 59100
cctcatctgt tacgccggcg gtagccggcc agcctcgcag agcaggattc ccgttgagca 59160
ccgccaggtg cgaataaggg acagtgaaga aggaacaccc gctcgcgggt gggcctactt 59220
cacctatcct gcccggctga cgccgttgga tacaccaagg aaagtctaca cgaacccttt 59280
ggcaaaatcc tgtatatcgt gcgaaaaagg atggatatac cgaaaaaatc gctataatga 59340
ccccgaagca gggttatgca gcggaaaagc gctgcttccc tgctgttttg tggaatatct 59400

accgactgga aacaggcaaa tgcaggaaat tactgaactg aggggacagg cgagagacga 59460
tgccaaagag ctacaccgac gagctggccg agtgggttga atcccgcgcg gccaagaagc 59520
gccggcgtga tgaggctgcg gttgcgttcc tggcggtgag ggcggatgtc gaggcggcgt 59580
tagcgtccgg ctatgcgctc gtcaccattt gggagcacat gcgggaaacg gggaaggtca 59640
agttctccta cgagacgttc cgctcgcacg ccaggcggca catcaaggcc aagcccgccg 59700
atgtgcccgc accgcaggcc aaggctgcgg aacccgcgcc ggcacccaag acgccggagc 59760
cacggcggcc gaagcagggg ggcaaggctg aaaagccggc ccccgctgcg gccccgaccg 59820
gcttcacctt caacccaaca ccggacaaaa aggatcaacc gggctgcatc cgatgcaagt 59880
gtgtcgctgt cgactcgttg tacaacgaaa tccattccca ttccgcgctc aagatggctt 59940
cccctcggca gttcatcagg gctaaatcaa tctagccgac ttgtccggtg aaatgggctg 60000
cactccaaca gaaacaatca aacaaacata cacagcgact tattcacacg agctcaaatt 60060
acaacggtat atat 60074

<210> 4
<211> 61092
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 4
cctgccagtc agcatcatca caccaaaagt taggcccgaa tagtttgaaa ttagaaagct 60
cgcaattgag gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg 120
atgcccccca tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac 180
tattacgtaa gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga 240
cgttacgtaa gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga 300
cgttacgtaa cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt 360
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa 420
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag 480
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa 540
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa 600
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac 660
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa 720
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt 780
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca 840
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac 900
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc 960
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtactgttta 1020
agcttcactg tctctgaatc ggcaaaggta aacgtatcaa ttattctaca aaccctttta 1080
tttttctttt gaattaccgt cttcattggt tatatgataa cttgataagt aaagcttcaa 1140
taattgaatt tgatctgtgt ttttttggcc ttaatactaa atccttacat aagctttgtt 1200
gcttctcctc ttgtgagttg agtgttaagt tgtaataatg gttcactttc agctttagaa 1260
gaaaccatgg aagttgttga gaggttctac ggagagttgg atggaaaggt ttcccaagga 1320
gtgaacgctt tgttgggatc tttcggagtt gagttgactg ataccccaac tactaaggga 1380
ttgccactcg ttgattctcc aactccaatt gtgttgggag tgtctgttta cttgaccatc 1440
gtgatcggag gattgctttg gatcaaggct agagatctca agccaagagc ttctgagcca 1500
ttcttgttgc aagctttggt gttggtgcac aacttgttct gcttcgcttt gtctctttac 1560
atgtgcgtgg gtatcgctta ccaagctatc acctggagat attccttgtg gggaaacgct 1620
tataacccaa agcacaagga gatggctatc ctcgtttacc tcttctacat gtccaagtac 1680
gtggagttca tggataccgt gatcatgatc ctcaagagat ccaccagaca gatttctttc 1740
ctccacgtgt accaccactc ttctatctcc cttatctggt gggctattgc tcaccacgct 1800
ccaggaggag aggcttattg gagtgctgct ctcaactctg gagtgcacgt gttgatgtac 1860
gcttactact tcttggctgc ttgcttgaga tcttccccaa agctcaagaa caagtacctc 1920
ttctggggaa gatacctcac ccaattccag atgttccagt tcatgctcaa cttggtgcaa 1980
gcttactacg atatgaaaac caacgctcca tatccacaat ggctcatcaa gatcctcttc 2040
tactacatga tctccctctt gttcctcttc ggaaacttct acgtgcaaaa gtacatcaag 2100
ccatccgatg gaaagcaaaa gggagctaag accgagtgat cgacaagctc gagtttctcc 2160
ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg gtttcgctca 2220
tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata cttctatcaa 2280
taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc ccgaattaat 2340
tcggcgttaa ttcagctagc tagcctcagc tgacgttacg taacgctagg tagcgtcacg 2400
tgacgttagc taacgctagg tagcgtcagc tgagcttacg taagcgctta gcagatattt 2460
ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg 2520
gacaacgttg ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca 2580
tgagttgcaa attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg 2640
agagagtctt tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag 2700
tctttttggt gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag 2760

gctgtaaaag attgtaaaag actattttgg tgttttggat aaaatgatag tttttataga 2820
ttcttttgct tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg 2880
aaatcgattg aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt 2940
ctctccattt ttatacctat ttaaccgtaa tcgattctaa tagatgatcg atttttttata 3000
taatcctaat taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat 3060
agaatcagta ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt 3120
tttaattttt ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc 3180
aaggtaagag aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa 3240
atgtacactt gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt 3300
attaaaatac cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa 3360
aagaacccac gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac 3420
tatataaacc caccatcccc aatctcacca aacccaccac acaactcaca actcactctc 3480
acaccttaaa gaaccaatca ccaccaaaaa atttcacgat ttggaatttg attcctgcga 3540
tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt ctttgtgatg 3600
ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga 3660
aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca tgttctttgt 3720
tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt cttactgatc 3780
gttattagga gtttggggaa aaaggaagag tttttttggt tggttcgagt gattatgagg 3840
ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac catgggaaaa 3900
ggatctgagg gaagatctgc tgctagagag atgactgctg aggctaacgg agataagaga 3960
aagaccatcc tcattgaggg agtgttgtac gatgctacca acttcaaaca cccaggaggt 4020
tccattatta acttcctcac cgagggagaa gctggagttg atgctaccca agcttacaga 4080
gagttccatc agagatccgg aaaggctgat aagtacctca agtccctccc aaagttggat 4140
gcttctaagg tggagtctag gttctctgct aaggagcagg ctagaaggga cgctatgacc 4200
agggattacg ctgctttcag agaggagttg gttgctgagg gatacttcga tccatctatc 4260
ccacacatga tctacagagt ggtggagatt gtggctttgt tcgctttgtc tttctggttg 4320
atgtctaagg cttctccaac ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa 4380
ggaagatgcg gatgggttat gcacgagatg ggacacggat ctttcactgg agttatctgg 4440
ctcgatgata ggatgtgcga gttcttctac ggagttggat gtggaatgtc tggacactac 4500
tggaagaacc agcactctaa gcaccacgct gctccaaaca gattggagca cgatgtggat 4560
ttgaacacct tgccactcgt tgctttcaac gagagagttg tgaggaaggt taagccagga 4620
tctttgttgg ctttgtggct cagagttcag gcttatttgt tcgctccagt gtcttgcttg 4680
ttgatcggat tgggatggac cttgtacttg cacccaagat atatgctcag gaccaagaga 4740
cacatggagt ttgtgtggat cttcgctaga tatatcggat ggttctcctt gatgggagct 4800
ttgggatatt ctcctggaac ttctgtggga atgtacctct gctctttcgg acttggatgc 4860
atctacatct tcctccaatt cgctgtgtct cacacccact tgccagttac caacccagag 4920
gatcaattgc actggcttga gtacgctgct gatcacaccg tgaacatctc taccaagtct 4980
tggttggtta cctggtggat gtctaacctc aacttccaaa tcgagcacca cttgttccca 5040
accgctccac aattcaggtt caaggagatc tctccaagag ttgaggctct cttcaagaga 5100
cacaacctcc cttactacga tttgccatac acctctgctg tttctactac cttcgctaac 5160
ctctactctg ttggacactc tgttggagct gataccaaga agcaggattg actgctttaa 5220
tgagatatgc gagacgccta tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt 5280
gtaaaaaacc tgagcatgtg tagctcagat ccttaccgcc ggtttcggtt cattctaatg 5340
aatatatcac ccgttactat cgtattttta tgaataatat tctccgttca atttactgat 5400
tgtctacgta ggctcagctg agcttaccta aggctacgta ggctcacgtg acgttacgta 5460
aggctacgta gcgtcacgtg agcttaccta actctagcta gcctcacgtg accttagcta 5520
acactaggta gcgtcagctc gacggcccgg actgtatcca acttctgatc tttgaatctc 5580
tctgttccaa catgttctga aggagttcta agacttttca gaaagcttgt aacatgcttt 5640
gtagactttc tttgaattac tcttgcaaac tctgattgaa cctacgtgaa aactgctcca 5700
gaagttctaa ccaaattccg tcttgggaag gcccaaaatt tattgagtac ttcagtttca 5760
tggacgtgtc ttcaaagatt tataacttga aatcccatca tttttaagag aagttctgtt 5820
ccgcaatgtc ttagatctca ttgaaatcta caactcttgt gtcagaagtt cttccagaat 5880
caacttgcat catggtgaaa atctggccag aagttctgaa cttgtcatat ttcttaacag 5940
ttagaaaaat ttctaagtgt ttagaatttt gacttttcca aagcaaactt gacttttgac 6000
tttcttaata aaacaaactt catattctaa catgtcttga tgaaatgtga ttcttgaaat 6060
ttgatgttga tgcaaaagtc aaagtttgac ttttcagtgt gcaattgacc attttgctct 6120
tgtgccaatt ccaaacctaa attgatgtat cagtgctgca aacttgatgt catggaagat 6180
cttatgagaa aattcttgaa gactgagagg aaaaatttttg tagtacaaca caaagaatcc 6240
tgtttttcat agtcggacta gacacattaa cataaaacac cacttcattc gaagagtgat 6300
tgaagaagga aatgtgcagt tacctttctg cagttcataa gagcaactta cagacacttt 6360
tactaaaata ctacaaagag gaagatttta acaacttaga gaagtaatgg gagttaaaga 6420
gcaacacatt aagggggagt gttaaaatta atgtgttgta accaccacta cctttagtaa 6480
gtattataag aaaattgtaa tcatcacatt ataattattg tccttattta aaattatgat 6540
aaagttgtat cattaagatt gagaaaacca aatagtcctc gtcttgattt ttgaattatt 6600
gttttctatg ttacttttct tcaagcctat ataaaaactt tgtaatgcta aattgtatgc 6660
tggaaaaaaa tgtgtaatga attgaataga aattatggta tttcaaagtc caaaatccat 6720
caatagaaat ttagtacaaa acgtaactca aaaatattct cttattttaa attttacaac 6780
aatataaaaa tattctctta ttttaaattt tacaataata taatttatca cctgtcacct 6840

```
ttagaatacc accaacaata ttaatactta gatattttat tcttaataat tttgagatct   6900
ctcaatatat ctgatattta ttttatattt gtgtcatatt ttcttatgtt ttagagttaa   6960
cccttatatc ttggtcaaac tagtaattca atatatgagt ttgtgaagga cacattgaca   7020
tcttgaaaca ttggttttaa ccttgttgga atgttaaagg taataaaaca ttcagaatta   7080
tgaccatcta ttaatatact tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat   7140
ggtaagctag agtgtcttgc tggcctgtgt atatcaattc catttccaga tggtagaaac   7200
tgccactacg aataattagt cataagacac gtatgttaac acacgtcccc ttgcatgttt   7260
tttgccatat attccgtctc tttctttttc ttcacgtata aaacaatgaa ctaattaata   7320
gagcgatcaa gctgaacagt tctttgcttt cgaagttgcc gcaacctaaa caggtttttc   7380
cttcttcttt cttcttatta actacgacct tgtcctttgc ctatgtaaaa ttactaggtt   7440
ttcatcagtt acactgatta agttcgttat agtggaagat aaaatgccct caaagcattt   7500
tgcaggatat ctttgatttt tcaaagatat ggaactgtag agtttgatag tgttcttgaa   7560
tgtggttgca tgaagttttt ttggtctgca tgttattttt tcctcgaaat atgttttgag   7620
tccaacaagt gattcacttg ggattcagaa agttgttttc tcaatatgta acagtttttt   7680
tctatggaga aaaatcatag ggaccgttgg ttttggcttc tttaattttg agctcagatt   7740
aaacccattt tacccggtgt tcttggcaga attgaaaaca gtacgtagta ccgcgcctac   7800
catgtgtgtt gagaccgaga acaacgatgg aatccctact gtggagatcg ctttcgatgg   7860
agagagagaa agagctgagg ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc   7920
tttggctaag accttcgcta gaagatacgt ggttatcgag ggagttgagt acgatgtgac   7980
cgatttcaaa catcctggag gaaccgtgat tttctacgct ctctctaaca ctggagctga   8040
tgctactgag gctttcaagg agttccacca cagatctaga aaggctagga aggctttggc   8100
tgctttgcct tctagacctg ctaagaccgc taaagtggat gatgctgaga tgctccagga   8160
tttcgctaag tggagaaagg agttggagag ggacggattc ttcaagcctt ctcctgctca   8220
tgttgcttac agattcgctg agttggctgc tatgtacgct ttgggaacct acttgatgta   8280
cgctagatac gttgtgtcct ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg   8340
atgggttcaa cacgagggag gacactcttc tttgaccgga aacatctggt gggataagag   8400
aatccaagct ttcactgctg gattcggatt ggctggatct ggagatatgt ggaactccat   8460
gcacaacaag caccacgcta ctcctcaaaa agtgaggcac gatatggatt tggataccac   8520
tcctgctgtt gctttcttca acaccgctgt ggaggataat agacctaggg gattctctaa   8580
gtactggctc agattgcaag cttggacctt cattcctgtg acttctggat tggtgttgct   8640
cttctggatg ttcttcctcc acccttctaa ggctttgaag ggaggaaagt acgaggagct   8700
tgtgtggatg ttggctgctc acgtgattag aacctggacc attaaggctg ttactggatt   8760
caccgctatg caatcctacg gactcttctt ggctacttct tgggtttccg gatgctactt   8820
gttcgctcac ttctctactt ctcacaccca cttggatgtt gttcctgctg atgagcactt   8880
gtcttgggtt aggtacgctg tggatcacac cattgatatc gatccttctc agggatgggt   8940
taactggttg atgggatact tgaactgcca agtgattcac cacctcttcc cttctatgcc   9000
tcaattcaga caacctgagg tgtccagaag attcgttgct ttcgctaaga agtggaacct   9060
caactacaag gtgatgactt atgctggagc ttggaaggct actttgggaa acctcgataa   9120
tgtgggaaag cactactacg tgcacggaca acactctgga aagaccgctt gattaatgaa   9180
ggccgcctcg accgtacccc ctgcagatag actatactat gttttagcct gcctgctggc   9240
tagctactat gttatgttat gttgtaaaat aaacacctgc taaggtatat ctatctatat   9300
tttagcatgg ctttctcaat aaattgtctt tccttatcgt ttactatctt atacctaata   9360
atgaaataat aatatcacat atgaggaacg gggcaggttt aggcatatat atacgagtgt   9420
agggcggagt ggggctacgt agcgtcacgt gacgttacct aagcctaggt agcctcagct   9480
gacgttacgt aacgctaggt aggctcagct gacacgggca ggacataggg actactacaa   9540
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa   9600
agtgctagag ggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca   9660
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg   9720
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa   9780
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat   9840
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc   9900
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag   9960
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata  10020
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag  10080
atttgtgcat tttgttgaat ataaattgac aatttttttt atttaattat agattattta  10140
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt  10200
aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca  10260
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt  10320
taatcgggta aaacctgatt actaaatata tattttttat ttgataaaca aaacaaaaat  10380
gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt  10440
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat  10500
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag  10560
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact  10620
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac  10680
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga  10740
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt  10800
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt  10860
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact  10920
```

tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata 10980
tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg 11040
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta 11100
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc 11160
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc 11220
gacattttta tcataaatct ggtgcttaaa cactctggtg agttctagta cttctgctat 11280
gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt tcttgatttt 11340
tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt tttttttgtg 11400
gttaatttag tttcctatgt tcttcgattg tattatgcat gatctgtgtt tggattctgt 11460
tagattatgt attggtgaat atgtatgtgt ttttgcatgt ctggttttgg tcttaaaaat 11520
gttcaaatct gatgatttga ttgaagcttt tttagtgttg gtttgattct tctcaaaact 11580
actgttaatt tactatcatg ttttccaact ttgattcatg atgacacttt tgttctgctt 11640
tgttataaaa ttttggttgg tttgattttg taattatagt gtaattttgt taggaatgaa 11700
catgttttaa tactctgttt tcgatttgtc acacattcga attattaatc gataatttaa 11760
ctgaaaattc atggttctag atcttgttgt catcagatta tttgtttcga taattcatca 11820
aatatgtagt ccttttgctg atttgcgact gtttcatttt ttctcaaaat tgtttttttgt 11880
taagtttatc taacagttat cgttgtcaaa agtctctttc attttgcaaa atcttctttt 11940
tttttttgtt tgtaactttg ttttttaagc tacacattta gtctgtaaaa tagcatcgag 12000
gaacagttgt cttagtagac ttgcatgttc ttgtaacttc tatttgtttc agtttgttga 12060
tgactgcttt gattttgtag gtcaaaggcg caccctacca tggatgctta taacgctgct 12120
atggataaga ttggagctgc tatcatcgat tggagtgatc cagatggaaa gttcagagct 12180
gatagggagg attggtggtt gtgcgatttc agatccgcta tcaccattgc tctcatctac 12240
atcgctttcg tgatcttggg atctgctgtg atgcaatctc tcccagctat ggacccatac 12300
cctatcaagt tcctctacaa cgtgtctcaa atcttcctct gcgcttacat gactgttgag 12360
gctggattcc tcgcttatag gaacggatac accgttatgc catgcaacca cttcaacgtg 12420
aacgatccac cagttgctaa cttgctctgg ctcttctaca tctccaaagt gtgggatttc 12480
tgggatacca tcttcattgt gctcggaaag aagtggagac aactctcttt cttgcacgtg 12540
taccaccaca ccaccatctt cctcttctac tggttgaacg ctaacgtgct ctacgatgga 12600
gatatcttct tgaccatcct cctcaacgga ttcattcaca ccgtgatgta cacctactac 12660
ttcatctgca tgcacaccaa ggattctaag accggaaagt ctttgccaat ctggtggaag 12720
tcatctttga ccgctttcca actcttgcaa ttcaccatca tgatgtccca agctacctac 12780
ttggttttcc acggatgcga taaggtttcc ctcagaatca ccatcgtgta cttcgtgtac 12840
attctctccc ttttcttcct cttcgctcag ttcttcgtgc aatcctacat ggctccaaag 12900
aagaagaagt ccgcttgatg ttaatgaagg ccgcagatat cagatctggt cgacctagag 12960
gatccccggc cgcaaagata ataacaaaag cctactatat aacgtacatg caagtattgt 13020
atgatattaa tgtttttacg tacgtgtaaa caaaaataat tacgtttgta acgtatggtg 13080
atgatgtggt gcactaggtg taggccttgt attaataaaa agaagtttgt tctatataga 13140
gtggtttagt acgacgattt atttactagt cggattggaa tagagaaccg aattcttcaa 13200
tccttgcttt tgatcaagaa ttgaaaccga atcaaatgta aaagttgata tatttgaaaa 13260
acgtattgag cttatgaaaa tgctaatact ctcatctgta tggaaaagtg actttaaaac 13320
cgaacttaaa agtgacaaaa ggggaatatc gcatcaaacc gaatgaaacc gatctacgta 13380
ggctcagctg agcttagcta agcctaccta gcctcacgtg agattatgta aggctaggta 13440
gcgtcacgtg acgttaccta acactagcta gcgtcagctg agcttagcta accctacgta 13500
gcctcacgtg agcttaccta acgctacgta gcctcacgtg actaaggatg acctacccat 13560
tcttgagaca aatgttacat tttagtatca gagtaaaatg tgtacctata actcaaattc 13620
gattgacatg tatccattca acataaaatt aaaccagcct gcacctgcat ccacatttca 13680
agtattttca aaccgttcgg ctcctatcca ccgggtgtaa caagacggat tccgaatttg 13740
gaagattttg actcaaattc ccaatttata ttgaccgtga ctaaatcaac tttaacttct 13800
ataattctga ttaagctccc aatttatatt cccaacggca ctacctccaa aatttataga 13860
ctctcatccc cttttaaacc aacttagtaa acgttttttt tttaatttta tgaagttaag 13920
tttttacctt gtttttaaaa agaatcgttc ataagatgcc atgccagaac attagctaca 13980
cgttacacat agcatgcagc cgcggagaat tgtttttctt cgccacttgt cactcccttc 14040
aaacacctaa gagcttctct ctcacagcac acacatacaa tcacatgcgt gcatgcatta 14100
ttacacgtga tcgccatgca aatctccttt atagcctata aattaactca tcggcttcac 14160
tctttactca aaccaaaact catcaataca aacaagatta aaaacatttc acgatttgga 14220
atttgattcc tgcgatcaca ggtatgacag gttagatttt gttttgtata gttgtataca 14280
tacttctttg tgatgttttg tttacttaat cgaatttttg gagtgtttta aggtctctcg 14340
tttagaaatc gtggaaaata tcactgtgtg tgtgttctta tgattcacag tgtttatggg 14400
tttcatgttc tttgttttat cattgaatgg gaagaaattt cgttgggata caaatttctc 14460
atgttcttac tgatcgttat taggagtttg gggaaaaagg aagagttttt ttggttggtt 14520
cgagtgatta tgaggttatt tctgtatttg atttatgagt taatggtcgt tttaatgttg 14580
tagaccgcca tggctatttt gaaccctgag gctgattctg ctgctaacct cgctactgat 14640
tctgaggcta agcaaagaca attggctgag gctggataca ctcacgttga gggtgctcct 14700
gctcctttgc ctttggagtt gcctcacttc tctctcagag atctcagagc tgctattcct 14760
aagcactgct tcgagagatc tttcgtgacc tccacctact acatgatcaa gaacgtgttg 14820
acttgcgctg ctttgttcta cgctgctacc ttcattgata gagctggagc tgctgcttat 14880
gttttgtggc ctgtgtactg gttcttccag ggatcttact tgactggagt gtgggttatc 14940
gctcacgagt gtggacacca ggcttattgc tcttctgagg tggtgaacaa cttgattgga 15000

ctcgtgttgc actctgcttt gttggtgcct taccactctt ggagaatctc tcacagaaag 15060
caccactcca acactggatc ttgcgagaac gatgaggttt tcgttcctgt gaccagatct 15120
gtgttggctt cttcttggaa cgagaccttg gaggattctc ctctctacca actctaccgt 15180
atcgtgtaca tgttggttgt tggatggatg cctggatacc tcttcttcaa cgctactgga 15240
cctactaagt actggggaaa gtctaggtct cacttcaacc cttactccgc tatctatgct 15300
gatagggaga ggtggatgat cgtgctctcc gatattttct tggtggctat gttggctgtt 15360
ttggctgctt tggtgcacac tttctccttc aacacgatgg tgaagttcta cgtggtgcct 15420
tacttcattg tgaacgctta cttggtgttg attacctacc tccaacacac cgatacctac 15480
atccctcact tcagagaggg agagtggaat tggttgagag gagctttgtg cactgtggat 15540
agatcatttg gtccattcct cgattctgtg gtgcatagaa tcgtggatac ccacgtttgc 15600
caccatatct tctccaagat gcctttctat cactgcgagg aggctaccaa cgctattaag 15660
cctctcctcg gaaagttcta cttgaaggat actactcctg ttcctgttgc tctctggaga 15720
tcttacaccc actgcaagtt cgttgaggat gatggaaagg tggtgttcta caagaacaag 15780
ttatagttaa tgaataattg attggttcga gtattatggc attgggaaaa ctgtttttct 15840
tgtaccattt gttgtgcttg taatttactg tgttttttat tcggttttcg ctatcgaact 15900
gtgaaatgga aatggatgga gaagagttaa tgaatgatat ggtccttttg ttcattctca 15960
aattaatatt atttgttttt tctcttattt gttgtgtgtt gaatttgaaa ttataagaga 16020
tatgcaaaca ttttgttttg agtaaaaatg tgtcaaatcg tggcctctaa tgaccgaagt 16080
taatatgagg agtaaaacac ttgtagttgt accattatgc ttattcacta ggcaacaaat 16140
atattttcag acctagaaaa gctgcaaatg ttactgaata caagtatgtc ctcttgtgtt 16200
ttagacattt atgaactttc ctttatgtaa ttttccagaa tccttgtcag attctaatca 16260
ttgctttata attatagtta tactcatgga tttgtagttg agtatgaaaa tattttttaa 16320
tgcattttat gacttgccaa ttgattgaca acatgcatca atctagctag cctcagctga 16380
cgttacgtaa cgctaggtag cgtcacgtga cgttagctaa cgctaggtag cgtcagctga 16440
gcttacgtaa gcgccacggg caggacatag ggactactac aagcatagta tgcttcagac 16500
aaagagctag gaaagaactc ttgatggagg ttaagagaaa aaagtgctag aggggcatag 16560
taatcaaact tgtcaaaacc gtcatcatga tgagggatga cataatataa aaagttgact 16620
aaggtcttgg tagtactctt tgattagtat tatatattgg tgagaacatg agtcaagagg 16680
agacaagaaa ccgaggaacc atagtttagc aacaagatgg aagttgcaaa gttgagctag 16740
ccgctcgatt agttacatct cctaagcagt actacaagga atggtctcta tactttcatg 16800
tttagcacat ggtagtgcgg attgacaagt tagaaacagt gcttaggaga caaagagtca 16860
gtaaaggtat tgaaagagtg aagttgatgc tcgacaggtc aggagaagtc cctccgccag 16920
atggtgacta ccaaggggtt ggtatcagct gagacccaaa taagattctt cggttgaacc 16980
agtggttcga ccgagactct tagggtggga tttcactgta agatttgtgc attttgttga 17040
atataaattg acaatttttt ttatttaatt atagattatt tagaatgaat tacatattta 17100
gtttctaaca aggatagcaa tggatgggta tgggtacagg ttaaacatat ctattaccca 17160
cccatctagt cgtcgggttt tacacgtacc cacccgttta cataaaccag accggaattt 17220
taaaccgtac ccgtccgtta gcgggtttca gatttacccg tttaatcggg taaaacctga 17280
ttactaaata tatatttttt atttgataaa caaaacaaaa atgttaatat tttcatattg 17340
gatgcaattt taagaaacac atattcataa atttccatat ttgtaggaaa ataaaaagaa 17400
aaatatattc aagaacacaa atttcaccga catgactttt attacagagt tggaattaga 17460
tctaacaatt gaaaaattaa aattaagata gaatatgttg aggaacatga catagtataa 17520
tgctgggtta cccgtcgggt aggtatcgag gcggatacta ctaaatccat cccactcgct 17580
atccgataat cactggtttc gggtataccc attcccgtca acaggccttt ttaaccggat 17640
aatttcaact tatagtgaat gaattttgaa taaatagtta gaataccaaa atcctggatt 17700
gcatttgcaa tcaaattttg tgaaccgtta aattttgcat gtacttggga tagatataat 17760
agaaccgaat tttcattagt ttaatttata acttactttg ttcaaagaaa aaaaatatct 17820
atccaattta cttataataa aaaataatct atccaagtta cttattataa tcaacttgta 17880
aaaaggtaag aatacaaatg tggtagcgta cgtgtgatta tatgtgacga aatgttatat 17940
ctaacaaaag tccaaattcc catggtaaaa aaaatcaaaa tgcatggcag gctgtttgta 18000
accttggaat aagatgttgg ccaattctgg agccgccacg tacgcaagac tcagggccac 18060
gttctcttca tgcaaggata gtagaacacc actccaccca cctcctatat tagacctttg 18120
cccaaccctc cccaactttc ccatcccatc cacaaagaaa ccgacatttt tatcataaat 18180
cagggtttcg tttttgtttc atcgataaac tcaaaggtga tgattttagg gtcttgtgag 18240
tgtgcttttt tgtttgattc tactgtaggg tttatgttct ttagctcata ggttttgtgt 18300
atttcttaga aatgtggctt ctttaatctc tgggtttgtg actttttgtg tggtttctgt 18360
gtttttcata tcaaaaacct attttttccg agtttttttt tacaaattct tactctcaag 18420
cttgaatact tcacatgcag tgttcttttg tagattttag agttaatgtg ttaaaaagtt 18480
tggatttttc ttgcttatag agcttcttca ctttgatttt gtgggttttt ttgttttaaa 18540
ggtgagattt ttgatgaggt ttttgcttca aagatgtcac ctttctgggt ttgtcttttg 18600
aataaagcta tgaactgtca catggctgac gcaattttgt tactatgtca tgaaagctga 18660
cgtttttccg tgttatacat gtttgcttac acttgcatgc gtcaaaaaaa ttggggcttt 18720
ttagttttag tcaaagattt tacttctctt ttgggattta tgaaggaaag ttgcaaactt 18780
tctcaaattt taccattttt gctttgatgt ttgtttagat tgcgacagaa caaactcata 18840
tatgttgaaa tttttgcttg gttttgtata ggattgtgtc ttttgcttat aaatgttgaa 18900
atctgaactt tttttttgtt tggtttcttt gagcaggaga taaggcgcac caccatggct 18960
tctacatctg ctgctcaaga cgctgctcct tacgagttcc cttctctcac tgagatcaag 19020
agggctcttc cttctgagtg tttcgaggct tctgttcctc tttctctcta ctacaccgct 19080

agatctcttg ctcttgctgg atctctcgct gttgctctct cttacgctag agctttgcct 19140
cttgttcagg ctaacgctct tcttgatgct actctctgca ctggatacgt tcttctccag 19200
ggaatcgttt tctggggatt cttcaccgtt ggtcacgatt gtggacacgg agctttctct 19260
agatctcacg tgctcaactt ctctgttgga accctcatgc actctatcat ccttacccct 19320
ttcgagtctt ggaagctctc tcacagacac caccacaaga acaccggaaa catcgataag 19380
gacgagatct tctaccctca aagagaggct gattctcacc ctgtttctag acaccttgtg 19440
atgtctcttg gatctgcttg gttcgcttac cttttcgctg gattccctcc tagaaccatg 19500
aaccacttca acccttggga ggctatgtat gttagaagag tggctgctgt gatcatctct 19560
ctcggagttc ttttcgcttt cgctggactc tactcttacc tcaccttcgt tcttggattc 19620
accactatgg ctatctacta cttcggacct ctcttcatct tcgctaccat gcttgttgtt 19680
accactttcc tccaccacaa cgatgaggag acaccttggt acgctgattc tgagtggact 19740
tacgtgaagg gaaacctctc ttctgtggac agatcttacg gtgctctcat cgacaacctt 19800
agccacaaca tcggaactca ccagatccac cacctcttcc ctatcatccc tcactacaag 19860
ctcaacgatg ctactgctgc tttcgctaag gctttccctg agcttgttag gaaaaacgct 19920
gctcctatca tcccaacttt cttcaggatg gctgctatgt acgctaagta cggagttgtt 19980
gacactgatg ctaagacctt cactctcaag gaggctaagg ctgctgctaa gactaagtca 20040
tcttgatgat taatgaaggc cgcagatatc agatctggtc gacctagagg atccccggcc 20100
gcaaagataa taacaaaagc ctactatata acgtacatgc aagtattgta tgatattaat 20160
gtttttacgt acgtgtaaac aaaaataatt acgtttgtaa cgtatggtga tgatgtggtg 20220
cactaggtgt aggccttgta ttaataaaaa gaagtttgtt ctatatagag tggtttagta 20280
cgacgattta tttactagtc ggattggaat agagaaccga attcttcaat ccttgctttt 20340
gatcaagaat tgaaaccgaa tcaaatgtaa aagttgatat atttgaaaaa cgtattgagc 20400
ttatgaaaat gctaatactc tcatctgtat ggaaaagtga ctttaaaacc gaacttaaaa 20460
gtgacaaaag gggaatatcg catcaaaccg aatgaaaccg atctacgtag gctcagctga 20520
gcttacctaa ggctacgtag gctcacgtga cgttacgtaa ggctacgtag cgtcacgtga 20580
gcttacctaa ctctagctag cctcacgtga ccttagctaa cactaggtag cgtcagcaca 20640
gatgaatact agctgttgtt cacagttcta gtgtctcctc attacgtgaa ttcaagctac 20700
gatcactatc tcaactccta cataaacatc agaatgctac aaaactatgc acaaaaacaa 20760
aagctacatc taatacgtga atcaattact ctcatcacaa gaaagaagat ttcaatcacc 20820
gtcgagaagg aggattcagt taattgaatc aaagttccga tcaaactcga agactggtga 20880
gcacgaggac gacgaagaag agtgtctcga agatacaaca agcaagaaat ctactgagtg 20940
acctcctgaa gttattggcg cgattgagag aatcaatccg aattaatttc ggggaaaaag 21000
ataaattaga tactaagcga tgggcttggg ctgggctaag aaacaggtgg caattgggct 21060
ggaggacccc gcgattcata gcttccgata gcccaaaaaa aaacggataa catatttatc 21120
gggtatttga atttcagtga aataagatat tttctttttg ttaggaaaat tttagaaaat 21180
aatggaaatt aaatagcgat tatgttacaa gatacgatca gcatcgggca gtgcaaaatg 21240
ctatagcttc ccaagatttg atcctttttgg gttatctcct aatgacaatt agtttaggat 21300
tttgaaactt atattaatac tattatccga caacacttgt ttcagcttct tattttaaca 21360
ttttttgttt ttttctattc ttcttcccat cagcattttc tttttaaaaa attgaatact 21420
ttaacttttt aaaaatttca caatgatcag atgatattat ggaagatctc aagagttaaa 21480
tgtatccatc ttggggcatt aaaaccggtg tacgggatga taaatacaga ctttatatca 21540
tatgatagct cagtaattca tatttatcac gttgctaaaa aaattataag gtactagtag 21600
tcaacaaaat caattaaaga gaaagaaaga aacgcatgtg aagagagttt acaactggaa 21660
aagtaaaata aaaattaacg catgttgaat gctgacatgt cagtatgtcc atgaatccac 21720
gtatcaagcg ccattcatcg atcgtcttcc tctttctaaa tgaaaacaac ttcacacatc 21780
acaacaaaca atacacacaa gaccccctct ctctcgttgt ctctctgcca gcgaccaaat 21840
cgaagcttga gaagaacaag aaggggtcaa accatgggaa aaggatctga gggaagatct 21900
gctgctagag agatgactgc tgaggctaac ggagataaga gaaagaccat cctcattgag 21960
ggagtgttgt acgatgctac caacttcaaa cacccaggag gttccattat taacttcctc 22020
accgagggag aagctggagt tgatgctacc caagcttaca gagagttcca tcagagatcc 22080
ggaaaggctg ataagtacct caagtccctc ccaaagttgg atgcttctaa ggtggagtct 22140
aggttctctg ctaaggagca ggctagaagg gacgctatga ccagggatta cgctgctttc 22200
agagaggagt tggttgctga gggatacttc gatccatcta tcccacacat gatctacaga 22260
gtggtggaga ttgtggcttt gttcgctttg tctttctggt tgatgtctaa ggcttctcca 22320
acctctttgg ttttgggagt ggtgatgaac ggaatcgctc aaggaagatg cggatgggtt 22380
atgcacgaga tgggacacgg atctttcact ggagttatct ggctcgatga taggatgtgc 22440
gagttcttct acggagttgg atgtggaatg tctggacact actggaagaa ccagcactct 22500
aagcaccacg ctgctccaaa cagattggag cacgatgtgg atttgaacac cttgccactc 22560
gttgctttca acgagagagt tgtgaggaag gttaagccag gatctttgtt ggctttgtgg 22620
ctcagagttc aggcttattt gttcgctcca gtgtcttgct tgttgatcgg attgggatgg 22680
accttgtact tgcacccaag atatatgctc aggaccaaga gacacatgga gtttgtgtgg 22740
atcttcgcta gatatatcgg atggttctcc ttgatgggag ctttgggata ttctcctgga 22800
acttctgtgg gaatgtacct ctgctctttc ggacttggat gcatctacat cttcctccaa 22860
ttcgctgtgt ctcacaccca cttgccagtt accaacccag aggatcaatt gcactggctt 22920
gagtacgctg ctgatcacac cgtgaacatc tctaccaagt cttggttggt tacctggtgg 22980
atgtctaacc tcaacttcca aatcgagcac cacttgttcc caaccgctcc acaattcagg 23040
ttcaaggaga tctctccaag agttgaggct ctcttcaaga gacacaacct cccttactac 23100
gatttgccat acacctctgc tgtttctact accttcgcta acctctactc tgttggacac 23160

tctgttggag ctgataccaa gaagcaggat tgatgattaa tgaataattg attgtacata 23220
ctatattttt tgtttacctt gtgttagttt aatgttcagt gtcctctctt tattgtggca 23280
cgtctctttg ttgtatgttg tgtctataca aagttgaaat aatggaaaga aaaggaagag 23340
tgtaatttgt tttgttttaa gtgtttataa atatatatat ataggtcatt tagatagttc 23400
taggtttcta taaaactctc tctctggaag tagaatctgt ttttgagagg atccagttgc 23460
ctactaatct cccccaaaac ccttcaagct taaccttcct cttcacaaca acagaggaaa 23520
cacatctctt gagctctgag ttctcttctt tgagcatgtc tatcgctaaa ctcatctgcc 23580
ttatagcttc cctcttctct tcatctctct ctctcaccat ttcgctgtaa aacttattct 23640
cctccctcag cctctctatc tcttccttca gcatctcaca attcccacca taatcgactg 23700
aggatgattc accgtcatca acttcagact cagcgttgta gtcgtcatga gtctcacaag 23760
ccttggacca agaagactca tcatcgcaag ttgatgattt atcatgatgc ttctctgagc 23820
cgtgtttgct acgtagcgtc acctgacgtt acgtaaggct acctaggctc acgtgacgtt 23880
acgtaacgct acgtagcgtc aggtgaggtt agctaacgct agctagcctc acctgacgtt 23940
aggtaaggct acgtagcgtc acctgagatt agctaagcct acctagactc acgtgacctt 24000
aggtaacgct acgtagcgtc aaagctttac aacgctacac aaaacttata accgtaatca 24060
ccattcatta acttaactac tatcacatgc attcatgaat tgaaacgaga aggatgtaaa 24120
tagttgggaa gttatctcca cgttgaagag atcgttagcg agagctgaaa gaccgaggga 24180
ggagacgccg tcaacacgga cagagtcgtc gaccctcaca tgaagtagga ggaatctccg 24240
tgaggagcca gagagacgtc tttggtcttc ggtttcgatc cttgatctga cggagaagac 24300
gagagaagtg cgactggact ccgtgaggac caacagagtc gtcctcggtt tcgatcgtcg 24360
gtattggtgg agaaggcgga ggaatctccg tgacgagcca gagagatgtc gtcggtcttc 24420
ggtttcgatc cttgatctga cggagaagac gagagaagtg cgacgagact ccgtgaggac 24480
caacagagtt gtcctcggtt tcgatcgtcg gtttcggcgg agaaggcgga ggaatctccg 24540
tgaggagcca gagagacgtc gttggtcttc ggtttcgatc cttgatctgt tggagaagac 24600
gagacaagtg ggacgagact caacgacgga gtcagagacg tcgtcggtct tcggtttcgg 24660
ccgagaaggc ggagtcggtc ttcggtttcg gccgagaagg cggaggagac gtcttcgatt 24720
tgggtctctc ctcttgacga agaaaacaaa gaacacgaga aataatgaga aagagaacaa 24780
aagaaaaaaa aataaaaata aaaataaaat ttggtcctct tatgtggtga cacgtggttt 24840
gaaacccacc aaataatcga tcacaaaaaa cctaagttaa ggatcggtaa taacctttct 24900
aattaatttt gatttatatt aaatcactct ttttatttat aaaccccact aaattatgcg 24960
atattgattg tctaagtaca aaaattctct cgaattcaat acacatgttt catatattta 25020
gccctgttca tttaatatta ctagcgcatt tttaatttaa aattttgtaa actttttttgg 25080
tcaaagaaca tttttttaat tagagacaga aatctagact ctttatttgg aataatagta 25140
ataaagatat attaggcaat gagtttatga tgttatgttt atatagttta tttcatttta 25200
aattgaaaag cattattttt atcgaaatga atctagtata caatcaatat ttatgttttt 25260
tcatcagata ctttcctatt ttttggcacc tttcatcgga ctactgattt atttcaatgt 25320
gtatgcatgc atgagcatga gtatacacat gtcttttaaa atgcatgtaa agcgtaacgg 25380
accacaaaag aggatccata caaatacatc tcatcgcttc ctctactatt ctccgacaca 25440
cacactgagc atggtgctta aacactctgg tgagttctag tacttctgct atgatcgatc 25500
tcattaccat ttcttaaatt tctctcccta aatattccga gttcttgatt tttgataact 25560
tcaggttttc tctttttgat aaatctggtc tttccatttt tttttttttg tggttaattt 25620
agtttcctat gttcttcgat tgtattatgc atgatctgtg tttggattct gttagattat 25680
gtattggtga atatgtatgt gtttttgcat gtctggtttt ggtcttaaaa atgttcaaat 25740
ctgatgattt gattgaagct tttttagtgt tggtttgatt cttctcaaaa ctactgttaa 25800
tttactatca tgttttccaa ctttgattca tgatgacact tttgttctgc tttgttataa 25860
aattttggtt ggtttgattt tgtaattata gtgtaatttt gttaggaatg aacatgtttt 25920
aatactctgt tttcgatttg tcacacattc gaattattaa tcgataattt aactgaaaat 25980
tcatggttct agatcttgtt gtcatcagat tatttgtttc gataattcat caaatatgta 26040
gtccttttgc tgatttgcga ctgtttcatt ttttctcaaa attgtttttt gttaagttta 26100
tctaacagtt atcgttgtca aaagtctctt tcattttgca aaatcttctt tttttttttg 26160
tttgtaactt tgttttttaa gctacacatt tagtctgtaa aatagcatcg aggaacagtt 26220
gtcttagtag acttgcatgt tcttgtaact tctatttgtt tcagtttgtt gatgactgct 26280
ttgattttgt aggtcaaacc gcgccatgtc tgctagcgga gctttgttgc ctgctatagc 26340
tttcgctgct tacgcttacg ctacctacgc ttatgctttc gagtggagcc acgctaacgg 26400
aatcgataac gtggatgcta gagagtggat tggagctttg tctttgagac tccctgcaat 26460
tgcaaccaca atgtacctct tgttctgcct tgtgggacct agattgatgg ctaagaggga 26520
ggcttttgat cctaagggat ttatgctcgc ttacaacgct taccaaaccg ctttcaacgt 26580
tgtggtgctc ggaatgttcg ctagagagat ctctggattg ggacaacctg tttggggatc 26640
tactatgcct tggagcgata ggaagtcctt caagattttg ttgggagtgt ggctccacta 26700
caacaataag tacctcgagt tgttggatac tgtgttcatg gtggctagga aaaagaccaa 26760
gcagctctct ttcttgcacg tgtaccacca cgctttgttg atttgggctt ggtggcttgt 26820
ttgtcacctc atggctacca acgattgcat cgatgcttat ttcggagctg cttgcaactc 26880
tttcatccac atcgtgatgt actcctacta cctcatgtct gctttgggaa ttaggtgccc 26940
ttggaagaga tatatcaccc aggctcagat gttgcaattc gtgatcgtgt tcgctcacgc 27000
tgttttcgtg ctcagacaaa agcactgccc tgttactttg ccttgggcac aaatgttcgt 27060
gatgacaaat atgttggtgc tcttcggaaa cttctacctc aaggcttact ctaacaagtc 27120
taggggagat ggagcttctt ctgttaagcc tgctgagact actagagcac cttctgtgag 27180
aagaaccagg tcaaggaaga tcgattgata gttaatgaac taagtttgat gtatctgagt 27240

gccaacgttt actttgtctt tcctttcttt tattggttat gattagatgt ttactatgtt 27300
ctctcttttt cgttataaat aaagaagttc aattcttcta tagtttcaaa cgcgatttta 27360
agcgtttcta tttaggttta catgatttct tttacaaaat catctttaaa atacagtata 27420
tttttagttt tcataaaata tttaaagaaa tgaaagttta taaacattca ctcctattct 27480
ctaattaagg atttgtaaaa caaaaatttt gtaagcatat cgatttatgc gttttgtctt 27540
aattagctca ctaaataata aataatagct tatgttgtgg gactgtttaa ttacctaact 27600
tagaactaaa atcaactctt tgtgctacct agagtcagct gagcttagct aacgctagct 27660
agtgtcagct gacgttacgt aaggctaact agcgtcacgt gaccttacgt aacgctacgt 27720
aggctcagct gagcttagct aaccctagct agtgtcacgt gagcttacgc tactatagaa 27780
aatgtgttat atcgacatga ccagacaaag gggcaacagt taacaaaaca attaattctt 27840
tcatttgaga ttaaggaagg taaggtacta aaaagattaa aaaaaatgag cttatctctt 27900
tgtttctgta ataataatat aagtgtgata aacttttaat ataataattg taattaggtt 27960
ttctacagat gagcaccact cagagacaag ataagaagaa aacaattttg ttaaacatga 28020
ttatagaaac ttttagttaa gtcttgaagt atcaatataa caaaaaaaag tacacacgac 28080
tatgacaata aacccactac cgtcaggtta tcatttcgat gaaatgtttt gatatcatta 28140
aatataacag tcacaaaaaa tcatctaatt ataacaatat aacttataca tatatttaac 28200
taaaaactta gagtttttgt aatgattcta attgatgatt agagtttata gaaatacaat 28260
taaataaaaa atataatttt aaaaaaacat agtaaagtca atgagatcct ctctgacctc 28320
agtgatcatt tagtcatgta tgtacaacaa tcattgttca tcacatgact gtaaaataaa 28380
taaggataaa cttgggaata tatataatat attgtattaa ataaaaaagg gaaatacaaa 28440
tatcaatttt agattcccga gttgacacaa ctcaccatgc acgctgccac ctcagctccc 28500
agctctcgtc acatgtctca tgtcagttag gtctttggtt tttagtcttt gacacaactc 28560
gccatgcatg ttgccacgtg agctcgttcc tcttcccatg atctcaccac tgggcatgca 28620
tgctgccacc tcagctggca cctcttctct atatgtccct agaggccatg cacagtgcca 28680
cctcagcact cctctcagaa cccatacgta cctgccaatc ggcttctctc cataaatatc 28740
tatttaaatt ataactaatt atttcatata cttaattgat gacgtggatg cattgccatc 28800
gttgtttaat aattgttaat tacgacatga taaataaaat gaaagtaaaa agtacgaaag 28860
attttccatt tgttgttgta taaatagaga agtgagtgat gcataatgca tgaatgcatg 28920
accgcgccac catgactgtt ggatacgacg aggagatccc attcgagcaa gttagggctc 28980
ataacaagcc agacgacgct tggtgtgcta ttcacggaca cgtgtacgac gttaccaagt 29040
tcgcttcagt tcacccagga ggagatatta tcttgctcgc tgctggaaag gaagctactg 29100
tcctctacga gacctaccat gttagaggag tgtctgacgc tgtgctcaga aagtacagaa 29160
taggaaagtt gccagacgga caaggaggag ctaacgagaa ggagaagaga accttgtctg 29220
gattgtcctc tgcttcttac tacacctgga actccgattt ctacagagtg atgagggaga 29280
gagttgtggc tagattgaag gagagaggaa aggctagaag aggaggatac gaactctgga 29340
tcaaggcttt cttgctcctt gttggattct ggtcctctct ttactggatg tgcaccctcg 29400
atccatcttt cggagctatc ttggctgcta tgtctttggg agtgttcgct gcttttgttg 29460
gaacctgcat ccaacacgat ggaaaccacg gagctttcgc tcaatctaga tgggttaaca 29520
aggtggcagg atggactttg gatatgatcg gagcttctgg aatgacttgg gagttccaac 29580
acgtgttggg acaccaccca tacactaact tgatcgagga ggagaacgga ttgcaaaagg 29640
tgtccggaaa gaagatggat accaagttgg ctgatcaaga gtctgatcca gatgtgttct 29700
ccacctaccc aatgatgaga ttgcaccctt ggcaccagaa gaggtggtat cacaggttcc 29760
agcacatcta cggacctttc atcttcggat tcatgaccat caacaaggtg gtgactcaag 29820
atgttggagt ggtgttgaga aagagactct tccaaatcga tgctgagtgc agatatgctt 29880
ccccaatgta cgttgctagg ttctggatta tgaaggcttt gaccgtgttg tatatggttg 29940
ctttgccttg ttatatgcaa ggaccttggc acggattgaa actcttcgct atcgctcact 30000
tcacttgcgg agaggttttg gctaccatgt tcatcgtgaa ccacattatc gagggagtgt 30060
cttacgcttc taaggatgct gttaagggaa ctatggctcc accaaagact atgcacggag 30120
tgaccccaat gaacaacact agaaaggagg ttgaggctga ggcttctaag tctggagctg 30180
tggttaagtc tgtgccattg gatgattggg ctgctgttca gtgccaaacc tctgtgaact 30240
ggtctgttgg atcttggttt tggaaccact tctctggagg actcaaccac caaatcgagc 30300
accacctctt cccaggattg tctcacgaga cctactacca catccaagac gtggttcaat 30360
ctacctgtgc tgagtacgga gttccatacc aacacgagcc atctttgtgg actgcttact 30420
ggaagatgct cgaacacctt agacaattgg gaaacgagga gactcacgag tcatggcaga 30480
gagctgcttg attaatgaac taagactccc aaaaccacct tccctgtgac agttaaaccc 30540
tgcttatacc tttcctccta ataatgttca tctgtcacac aaactaaaat aaataaaatg 30600
ggagcaataa ataaaatggg agctcatata tttacaccat ttacactgtc tattattcac 30660
catgccaatt attacttcat aattttaaaa ttatgtcatt tttaaaaatt gcttaatgat 30720
ggaaaggatt attataagtt aaaagtataa catagataaa ctaaccacaa aacaaatcaa 30780
tataaactaa cttactctcc catctaattt ttatttaaat ttctttacac ttctcttcca 30840
tttctatttc tacaacatta tttaacattt ttattgtatt tttcttactt tctaactcta 30900
ttcatttcaa aaatcaatat atgtttatca ccacctctct aaaaaaaact ttacaatcat 30960
tggtccagaa aagttaaatc acgagatggt cattttagca ttaaaacaac gattcttgta 31020
tcactatttt tcagcatgta gtccattctc ttcaaacaaa gacagcggct atataatcgt 31080
tgtgttatat tcagtctaaa acaactacgt agcgtcacgt gacgttacct aagcctaggt 31140
agcctcagct gacgttacgt aacgctaggt aggctcagct gactgcagca aatttacaca 31200
ttgccactaa acgtctaaac ccttgtaatt tgtttttgtt ttactatgtg tgttatgtat 31260
ttgatttgcg ataaattttt atatttggta ctaaatttat aacacctttt atgctaacgt 31320

ttgccaacac ttagcaattt gcaagttgat taattgattc taaattattt ttgtcttcta 31380
aatacatata ctaatcaact ggaaatgtaa atatttgcta atatttctac tataggagaa 31440
ttaaagtgag tgaatatggt accacaaggt ttggagattt aattgttgca atgctgcatg 31500
gatggcatat acaccaaaca ttcaataatt cttgaggata ataatggtac cacacaagat 31560
ttgaggtgca tgaacgtcac gtggacaaaa ggtttagtaa tttttcaaga caacaatgtt 31620
accacacaca agttttgagg tgcatgcatg gatgccctgt ggaaagttta aaaatatttt 31680
ggaaatgatt tgcatggaag ccatgtgtaa aaccatgaca tccacttgga ggatgcaata 31740
atgaagaaaa ctacaaattt acatgcaact agttatgcat gtagtctata taatgaggat 31800
tttgcaatac tttcattcat acacactcac taagttttac acgattataa tttcttcata 31860
gccagtactg tttaagcttc actgtctctg aatcggcaaa ggtaaacgta tcaattattc 31920
tacaaaccct tttatttttc ttttgaatta ccgtcttcat tggttatatg ataacttgat 31980
aagtaaagct tcaataattg aatttgatct gtgttttttt ggccttaata ctaaatcctt 32040
acataagctt tgttgcttct cctcttgtga gttgagtgtt aagttgtaat aatggttcac 32100
tttcagcttt agaagaaacg cgccttccat ggctacaaag gaggcttacg ttttcccaac 32160
tctcaccgag atcaagagat ctctcccaaa ggattgcttc gaggcttctg tgcctttgtc 32220
tctctactac actgtgagat gcttggttat tgctgtggct ttgaccttcg gattgaacta 32280
cgctagagct ttgccagagg ttgagtcttt ctgggctttg gatgctgctt tgtgcactgg 32340
atatatcctc ctccagggaa ttgtgttctg ggattcttc actgttggac acgatgctgg 32400
acacggagct ttctctagat accacctctt gaacttcgtt gtgggaacct tcatgcactc 32460
tctcatcttg accccattcg agtcttggaa gttgacccac agacaccacc acaagaacac 32520
cggaaacatc gatagagatg aggtgttcta cccacagaga aaggctgatg atcacccatt 32580
gtccaggaac ttgatcttgg ctttgggagc tgcttggctt gcttatttgg tggagggatt 32640
cccaccaaga aaggtgaacc acttcaaccc attcgagcca ctttttgtga gacaagtgtc 32700
cgctgtggtt atctctttgc tcgctcactt cttcgttgct ggactctcta tctacttgtc 32760
tctccagttg ggacttaaga ccatggctat ctactactac ggaccagttt tcgtgttcgg 32820
atctatgttg gtgattacca ccttcttgca ccacaacgat gaggagactc catggtatgc 32880
tgattctgag tggacttacg tgaagggaaa cttgtcctct gtggatagat cttacggtgc 32940
tctcatcgat aacctctccc acaacatcgg aactcaccag atccaccacc tcttcccaat 33000
tatcccacac tacaagctca agaaggctac tgctgctttc caccaagctt tcccagagct 33060
tgtgagaaag tccgatgagc caatcatcaa ggctttcttc agagtgggaa ggttgtatgc 33120
taactacgga gtggttgatc aagaggctaa gctcttcact ttgaaggagg ctaaggctgc 33180
tactgaagct gctgctaaga ccaagtctac ctgattaatg aatcgacaag ctcgagtttc 33240
tccataataa tgtgtgagta gttcccagat aagggaatta gggttcctat agggtttcgc 33300
tcatgtgttg agcatataag aaacccttag tatgtatttg tatttgtaaa atacttctat 33360
caataaaatt tctaattcct aaaaccaaaa tccagtacta aaatccagat cccccgaatt 33420
aattcggcgt taattcagct acgtagcgtc acctgacgtt acgtaaggct acctaggctc 33480
acgtgacgtt acgtaacgct acgtagcgtc aggtgaggtt agctaacgct agctagcctc 33540
acctgacgtt aggtaaggct acgtagcgtc acctgagatt agctaagcct acctagactc 33600
acgtgacctt aggtaacgct acgtagcgtc aaagctttac aacgctacac aaaacttata 33660
accgtaatca ccattcatta acttaactac tatcacatgc attcatgaat tgaaacgaga 33720
aggatgtaaa tagttgggaa gttatctcca cgttgaagag atcgttagcg agagctgaaa 33780
gaccgaggga ggagacgccg tcaacacgga cagagtcgtc gaccctcaca tgaagtagga 33840
ggaatctccg tgaggagcca gagagacgtc tttggtcttc ggtttcgatc cttgatctga 33900
cggagaagac gagagaagtg cgactggact ccgtgaggac caacagagtc gtcctcggtt 33960
tcgatcgtcg gtattggtgg agaaggcgga ggaatctccg tgacgagcca gagagatgtc 34020
gtcggtcttc ggtttcgatc cttgatctga cggagaagac gagagaagtg cgacgagact 34080
ccgtgaggac caacagagtt gtcctcggtt tcgatcgtcg gtttcggcgg agaaggcgga 34140
ggaatctccg tgaggagcca gagagacgtc gttggtcttc ggtttcgatc cttgatctgt 34200
tggagaagac gagacaagtg ggacgagact caacgacgga gtcagagacg tcgtcggtct 34260
tcggtttcgg ccgagaaggc ggagtcggtc ttcggtttcg gccgagaagg cggaggagac 34320
gtcttcgatt tgggtctctc ctcttgacga agaaaacaaa gaacacgaga aataatgaga 34380
aagagaacaa aagaaaaaaa aataaaaata aaaataaaat ttggtcctct tatgtggtga 34440
cacgtggttt gaaacccacc aaataatcga tcacaaaaaa cctaagttaa ggatcggtaa 34500
taacctttct aattaatttt gatttatatt aaatcactct ttttatttat aaaccccact 34560
aaattatgcg atattgattg tctaagtaca aaaattctct cgaattcaat acacatgttt 34620
catatattta gccctgttca tttaatatta ctagcgcatt tttaatttaa aattttgtaa 34680
acttttttgg tcaaagaaca ttttttttaat tagagacaga aatctagact ctttatttgg 34740
aataatagta ataaagatat attaggcaat gagtttatga tgttatgttt atatagttta 34800
tttcatttta aattgaaaag cattattttt atcgaaatga atctagtata caatcaatat 34860
ttatgttttt tcatcagata ctttcctatt ttttggcacc tttcatcgga ctactgattt 34920
atttcaatgt gtatgcatgc atgagcatga gtatacacat gtcttttaaa atgcatgtaa 34980
agcgtaacgg accacaaaag aggatccata caaatacatc tcatcgcttc ctctactatt 35040
ctccgacaca cacactgagc atggtgctta aacactctgg tgagttctag tacttctgct 35100
atgatcgatc tcattaccat ttcttaaatt tctctcccta aatattccga gttcttgatt 35160
tttgataact tcaggttttc tctttttgat aaatctggtc tttccatttt tttttttttg 35220
tggttaattt agtttcctat gttcttcgat tgtattatgc atgatctgtg tttggattct 35280
gttagattat gtattggtga atatgtatgt gtttttgcat gtctggtttt ggtcttaaaa 35340
atgttcaaat ctgatgattt gattgaagct tttttagtgt tggtttgatt cttctcaaaa 35400

ctactgttaa tttactatca tgttttccaa ctttgattca tgatgacact tttgttctgc 35460
tttgttataa aattttggtt ggtttgattt tgtaattata gtgtaatttt gttaggaatg 35520
aacatgtttt aatactctgt tttcgatttg tcacacattc gaattattaa tcgataattt 35580
aactgaaaat tcatggttct agatcttgtt gtcatcagat tatttgtttc gataattcat 35640
caaatatgta gtccttttgc tgatttgcga ctgtttcatt ttttctcaaa attgtttttt 35700
gttaagttta tctaacagtt atcgttgtca aaagtctctt tcattttgca aaatcttctt 35760
tttttttttg tttgtaactt tgttttttaa gctacacatt tagtctgtaa aatagcatcg 35820
aggaacagtt gtcttagtag acttgcatgt tcttgtaact tctatttgtt tcagtttgtt 35880
gatgactgct ttgattttgt aggtcaaacc gcgccatgcc acctagtgct gctagtgaag 35940
gtggtgttgc tgaacttaga gctgctgaag ttgctagcta cactagaaag gctgttgacg 36000
aaagacctga cctcactata gttggtgacg ctgtttacga cgctaaggct tttagggacg 36060
agcaccctgg tggtgctcac ttcgttagcc ttttcggagg tagggacgct actgaggctt 36120
ttatggaata tcaccgtaga gcttggccta aggctaggat gtctaagttc ttcgttggtt 36180
cacttgacgc tagcgagaag cctactcaag ctgattcagc ttaccttaga ctttgcgctg 36240
aggttaacgc tcttttgcct aagggtagcg gaggattcgc tcctcctagc tactggctta 36300
aggctgctgc tcttgttgtt gctgctgtta gtatagaggg ttatatgctc cttaggggta 36360
agaccctttt gcttagcgtt ttccttggac tcgtgttcgc ttggatagga cttaatattc 36420
agcacgacgc taatcacggt gctcttagta gacactcagt gattaactac tgcctcggtt 36480
acgctcagga ttggataggt ggtaatatgg tgctttggct tcaagagcac gttgtgatgc 36540
accacctcca cactaacgac gttgacgctg atcctgatca aaaggctcac ggtgttctta 36600
gacttaagcc tactgacggt tggatgcctt ggcacgcact tcaacaactc tatatccttc 36660
ctggtgaggc tatgtacgct tttaagcttc ttttcttgga cgcccttgag cttcttgctt 36720
ggaggtggga gggtgagaag attagccctc ttgctagagc tttgttcgct cctgctgttg 36780
cttgtaagct tggattctgg gctagattcg ttgctctccc tctctggctt caacctactg 36840
ttcacactgc tttgtgtatc tgtgctactg tgtgtactgg tagcttctac ctcgccttct 36900
tcttctttat ctctcacaac ttcgacggtg ttggtagcgt tggacctaag ggatcacttc 36960
ctagatcagc tactttcgtt caacgtcagg ttgagactag ctctaacgtt ggtggttact 37020
ggcttggagt tcttaacggt ggacttaact ttcagataga gcaccacttg ttccctaggc 37080
ttcaccactc ttactacgct caaatagctc ctgtggttag gactcacata gagaagctcg 37140
gttttaagta ccgtcacttc cctaccgttg gatctaacct tagctcaatg cttcagcata 37200
tgggtaagat gggaactaga cctggtgctg agaagggtgg taaggctgag tagtagttaa 37260
tgaactaagt ttgatgtatc tgagtgccaa cgtttacttt gtctttcctt tcttttattg 37320
gttatgatta gatgtttact atgttctctc tttttcgtta taaataaaga agttcaattc 37380
ttctatagtt tcaaacgcga ttttaagcgt ttctatttag gtttacatga tttcttttac 37440
aaaatcatct ttaaaataca gtatattttt agttttcata aaatatttaa agaaatgaaa 37500
gtttataaac attcactcct attctctaat taaggatttg taaaacaaaa attttgtaag 37560
catatcgatt tatgcgtttt gtcttaatta gctcactaaa taataaataa tagcttatgt 37620
tgtgggactg tttaattacc taacttagaa ctaaaatcaa ctctttgtgc tagctagcct 37680
cagctgacgt tacgtaacgc taggtagcgt cacgtgacgt tagctaacgc taggtagcgt 37740
cagctgagct tacgtaagcg cacagatgaa tactagctgt tgttcacagt tctagtgtct 37800
cctcattacg tgaattcaag ctacgatcac tatctcaact cctacataaa catcagaatg 37860
ctacaaaact atgcacaaaa acaaaagcta catctaatac gtgaatcaat tactctcatc 37920
acaagaaaga agatttcaat caccgtcgag aaggaggatt cagttaattg aatcaaagtt 37980
ccgatcaaac tcgaagactg gtgagcacga ggacgacgaa gaagagtgtc tcgaagatac 38040
aacaagcaag aaatctactg agtgacctcc tgaagttatt ggcgcgattg agagaatcaa 38100
tccgaattaa tttcggggaa aaagataaat tagatactaa gcgatgggct tgggctgggc 38160
taagaaacag gtggcaattg ggctggagga ccccgcgatt catagcttcc gatagcccaa 38220
aaaaaaacgg ataacatatt tatcgggtat ttgaatttca gtgaaataag atattttctt 38280
tttgttagga aaattttaga aaataatgga aattaaatag cgattatgtt acaagatacg 38340
atcagcatcg ggcagtgcaa aatgctatag cttcccaaga tttgatcctt ttgggttatc 38400
tcctaatgac aattagttta ggattttgaa acttatatta atactattat ccgacaacac 38460
ttgtttcagc ttcttatttt aacatttttt gttttttttct attcttcttc ccatcagcat 38520
tttcttttta aaaaattgaa tactttaact ttttaaaaat ttcacaatga tcagatgata 38580
ttatggaaga tctcaagagt taaatgtatc catcttgggg cattaaaacc ggtgtacggg 38640
atgataaata cagactttat atcatatgat agctcagtaa ttcatattta tcacgttgct 38700
aaaaaaatta taaggtacta gtagtcaaca aaatcaatta aagagaaaga aagaaacgca 38760
tgtgaagaga gtttacaact ggaaaagtaa aataaaaatt aacgcatgtt gaatgctgac 38820
atgtcagtat gtccatgaat ccacgtatca agcgccattc atcgatcgtc ttcctctttc 38880
taaatgaaaa caacttcaca catcacaaca aacaatacac acaagacccc ctctctctcg 38940
ttgtctctct gccagcgacc aaatcgaagc ttgagaagaa caagaagggg tcaaaccatg 39000
gcttctacat ctgctgctca agacgctgct ccttacgagt tcccttctct cactgagatc 39060
aagagggctc ttccttctga gtgtttcgag gcttctgttc ctctttctct ctactacacc 39120
gctagatctc ttgctcttgc tggatctctc gctgttgctc tctcttacgc tagagctttg 39180
cctcttgttc aggctaacgc tcttcttgat gctactctct gcactggata cgttcttctc 39240
cagggaatcg ttttctgggg attcttcacc gttggtcacg attgtggaca cggagctttc 39300
tctagatctc acgtgctcaa cttctctgtt ggaaccctca tgcactctat catccttacc 39360
cctttcgagt cttggaagct ctctcacaga caccaccaca agaacaccgg aaacatcgat 39420
aaggacgaga tcttctaccc tcaaagagag gctgattctc accctgtttc tagacacctt 39480

gtgatgtctc ttggatctgc ttggttcgct taccttttcg ctggattccc tcctagaacc 39540
atgaaccact tcaacccttg ggaggctatg tatgttagaa gagtggctgc tgtgatcatc 39600
tctctcggag ttcttttcgc tttcgctgga ctctactctt acctcacctt cgttcttgga 39660
ttcaccacta tggctatcta ctacttcgga cctctcttca tcttcgctac catgcttgtt 39720
gttaccactt tcctccacca caacgatgag gagacacctt ggtacgctga ttctgagtgg 39780
acttacgtga agggaaacct ctcttctgtg gacagatctt acggtgctct catcgacaac 39840
cttagccaca acatcggaac tcaccagatc caccacctct tccctatcat ccctcactac 39900
aagctcaacg atgctactgc tgctttcgct aaggctttcc ctgagcttgt taggaaaaac 39960
gctgctccta tcatcccaac tttcttcagg atggctgcta tgtacgctaa gtacggagtt 40020
gttgacactg atgctaagac cttcactctc aaggaggcta aggctgctgc taagactaag 40080
tcatcttgat gattaatgaa taattgattg tacatactat atttttttgtt taccttgtgt 40140
tagtttaatg ttcagtgtcc tctctttatt gtggcacgtc tctttgttgt atgttgtgtc 40200
tatacaaagt tgaaataatg gaaagaaaag gaagagtgta atttgttttg ttttaagtgt 40260
ttataaatat atatatatag gtcatttaga tagttctagg tttctataaa actctctctc 40320
tggaagtaga atctgttttt gagaggatcc agttgcctac taatctcccc caaaaccctt 40380
caagcttaac cttcctcttc acaacaacag aggaaacaca tctcttgagc tctgagttct 40440
cttctttgag catgtctatc gctaaactca tctgccttat agcttccctc ttctcttcat 40500
ctctctctct caccatttcg ctgtaaaact tattctcctc cctcagcctc tctatctctt 40560
ccttcagcat ctcacaattc ccaccataat cgactgagga tgattcaccg tcatcaactt 40620
cagactcagc gttgtagtcg tcatgagtct cacaagcctt ggaccaagaa gactcatcat 40680
cgcaagttga tgatttatca tgatgcttct ctgagccgtg tttgctagct agcctcagct 40740
gacgttacgt aacgctaggt agcgtcacgt gacgttagct aacgctaggt agcgtcagct 40800
gagcttacgt aagcgcttaa ttaaagtact gatatcggta ccaaatcgaa tccaaaaatt 40860
acggatatga atataggcat atccgtatcc gaattatccg tttgacagct agcaacgatt 40920
gtacaattgc ttctttaaaa aaggaagaaa gaaagaaaga aaagaatcaa catcagcgtt 40980
aacaaacggc cccgttacgg cccaaacggt catatagagt aacggcgtta agcgttgaaa 41040
gactcctatc gaaatacgta accgcaaacg tgtcatagtc agatcccctc ttccttcacc 41100
gcctcaaaca caaaaataat cttctacagc ctatatatac aacccccccct tctatctctc 41160
ctttctcaca attcatcatc tttctttctc tacccccaat tttaagaaat cctctcttct 41220
cctcttcatt ttcaaggtaa atctctctct ctctctctct ctctgttatt ccttgtttta 41280
attaggtatg tattattgct agtttgttaa tctgcttatc ttatgtatgc cttatgtgaa 41340
tatctttatc ttgttcatct catccgttta gaagctataa atttgttgat ttgactgtgt 41400
atctacacgt ggttatgttt atatctaatc agatatgaat ttcttcatat tgttgcgttt 41460
gtgtgtacca atccgaaatc gttgattttt ttcatttaat cgtgtagcta attgtacgta 41520
tacatatgga tctacgtatc aattgttcat ctgtttgtgt ttgtatgtat acagatctga 41580
aaacatcact tctctcatct gattgtgttg ttacatacat agatatagat ctgttatatc 41640
atttttttta ttaattgtgt atatatatat gtgcatagat ctggattaca tgattgtgat 41700
tatttacatg attttgttat ttacgtatgt atatatgtag atctggactt tttggagttg 41760
ttgacttgat tgtatttgtg tgtgtatatg tgtgttctga tcttgatatg ttatgtatgt 41820
gcagctgaac catggcggcg gcaacaacaa caacaacaac atcttcttcg atctccttct 41880
ccaccaaacc atctccttcc tcctccaaat caccattacc aatctccaga ttctccctcc 41940
cattctccct aaaccccaac aaatcatcct cctcctcccg ccgccgcggt atcaaatcca 42000
gctctccctc ctccatctcc gccgtgctca acacaaccac caatgtcaca accactccct 42060
ctccaaccaa acctaccaaa cccgaaacat tcatctcccg attcgctcca gatcaacccc 42120
gcaaaggcgc tgatatcctc gtcgaggctt tagaacgtca aggcgtagaa accgtattcg 42180
cttaccctgg aggtacatca atggagattc accaagcctt aacccgctct tcctcaatcc 42240
gtaacgtcct tcctcgtcac gaacaaggag gtgtattcgc agcagaagga tacgctcgat 42300
cctcaggtaa accaggtatc tgtatagcca cttcaggtcc cggagctaca aatctcgtta 42360
gcggattagc cgatgcgttg ttagatagtg ttcctcttgt agcaatcaca ggacaagtcc 42420
ctcgtcgtat gattggtaca gatgcgtttc aagagactcc gattgttgag gtaacgcgtt 42480
cgattacgaa gcataactat cttgtgatgg atgttgaaga tatcccaagg attattgaag 42540
aggctttctt tttagctact tctggtagac ctggacctgt tttggttgat gttcctaaag 42600
atattcaaca acagcttgcg attcctaatt gggaacaggc tatgagatta cctggttata 42660
tgtctaggat gcctaaacct ccggaagatt ctcatttgga gcagattgtt aggttgattt 42720
ctgagtctaa gaagcctgtg ttgtatgttg gtggtggttg tcttaattct agcgatgaat 42780
tgggtaggtt tgttgagctt acgggcatcc ctgttgcgag tacgttgatg ggctgggat 42840
cttatccttg tgatgatgag ttgtcgttac atatgcttgg aatgcatggg actgtgtatg 42900
caaattacgc tgtggagcat agtgatttgt tgttggcgtt tggggtaagg tttgatgatc 42960
gtgtcacggg taaacttgag gcttttgcta gtagggctaa gattgttcat attgatattg 43020
actcggctga gattgggaag aataagactc ctcatgtgtc tgtgtgtggt gatgttaagc 43080
tggctttgca agggatgaat aaggttcttg agaaccgagc ggaggagctt aaacttgatt 43140
ttggagtttg gaggaatgag ttgaacgtac agaaacagaa gtttccgttg agctttaaga 43200
cgtttgggga agctattcct ccacagtatg cgattaaggt ccttgatgag ttgactgatg 43260
gaaaagccat aataagtact ggtgtcgggc aacatcaaat gtgggcggcg cagttctaca 43320
attacaagaa accaaggcag tggctatcat caggaggcct tggagctatg ggatttggac 43380
ttcctgctgc gattggagcg tctgttgcta accctgatgc gatagttgtg gatattgacg 43440
gagatggaag ttttataatg aatgtgcaag agctagccac tattcgtgta gagaatcttc 43500
cagtgaaggt acttttatta aacaaccagc atcttggcat ggttatgcaa tgggaagatc 43560

ggttctacaa agctaaccga gctcacacat ttctcgggga cccggctcag gaggacgaga 43620
tattcccgaa catgttgctg tttgcagcag cttgcgggat tccagcggcg agggtgacaa 43680
agaaagcaga tctccgagaa gctattcaga caatgctgga tacaccagga ccttacctgt 43740
tggatgtgat ttgtccgcac caagaacatg tgttgccgat gatcccgaat ggtggcactt 43800
tcaacgatgt cataacggaa ggagatggcc ggattaaata ctgagagatg aaaccggtga 43860
ttatcagaac cttttatggt ctttgtatgc atatggtaaa aaaacttagt ttgcaatttc 43920
ctgtttgttt tggtaatttg agtttctttt agttgttgat ctgcctgctt tttggtttac 43980
gtcagactac tactgctgtt gttgtttggt ttcctttctt tcattttata aataaataat 44040
ccggttcggt ttactccttg tgactggctc agtttggtta ttgcgaaatg cgaatggtaa 44100
attgagtaat tgaaattcgt tattagggtt ctaagctgtt ttaacagtca ctgggttaat 44160
atctctcgaa tcttgcatgg aaaatgctct taccattggt ttttaattga aatgtgctca 44220
tatgggccgt ggtttccaaa ttaaataaaa ctacgatgtc atcgagaagt aaaatcaact 44280
gtgtccacat tatcagtttt gtgtatacga tgaaataggg taattcaaaa tctagcttga 44340
tatgcctttt ggttcatttt aaccttctgt aaacattttt tcagattttg aacaagtaaa 44400
tccaaaaaaa aaaaaaaaaa tctcaactca acactaaatt attttaatgt ataaaagatg 44460
cttaaaacat ttggcttaaa agaaagaagc taaaaacata gagaactctt gtaaattgaa 44520
gtatgaaaat atactgaatt gggtattata tgaattttttc tgatttagga ttcacatgat 44580
ccaaaaagga aatccagaag cactaatcag acattggaag taggattaat cagtgatcag 44640
taactattaa attcaattaa ccgcggacat ctacattttt gaattgaaaa aaaattggta 44700
attactcttt ctttttctcc atattgacca tcatactcat tgctgatcca tgtagatttc 44760
ccggacatga agccatttac aattgaatat atcctgccgc cgctgccgct ttgcacccgg 44820
tggagcttgc atgttggttt ctacgcagaa ctgagccggt taggcagata atttccattg 44880
agaactgagc catgtgcacc ttccccccaa cacggtgagc gacggggcaa cggagtgatc 44940
cacatgggac ttttaaacat catccgtcgg atggcgttgc gagagaagca gtcgatccgt 45000
gagatcagtc gaccaattct catgtttgac agcttatcat cgaatttctg ccattcatcc 45060
gcttattatc acttattcag gcgtagcaac caggcgttta agggcaccaa taactgcctt 45120
aaaaaaatta cgccccgccc tgccactcat cgcagtactg ttgtaattca ttaagcattc 45180
tgccgacatg gaagccatca caaacggcat gatgaacctg aatcgccagc ggcatcagca 45240
ccttgtcgcc ttgcgtataa tatttgccca tggtgaaaac gggggcgaag aagttgtcca 45300
tattggccac gtttaaatca aaactggtga aactcaccca gggattggct gagacgaaaa 45360
acatattctc aataaaccct ttagggaaat aggccaggtt ttcaccgtaa cacgccacat 45420
cttgcgaata tatgtgtaga aactgccgga aatcgtcgtg gtattcactc cagagcgatg 45480
aaaacgtttc agtttgctca tggaaaacgg tgtaacaagg gtgaacacta tcccatatca 45540
ccagctcacc gtctttcatt gccatacgga attccggatg agcattcatc aggcgggcaa 45600
gaatgtgaat aaaggccgga taaaacttgt gcttattttt ctttacggtc tttaaaaagg 45660
ccgtaatatc caggacctgc aggggggggg gggcgctgag gtctgcctcg tgaagaaggt 45720
gttgctgact cataccaggc ctgaatcgcc ccatcatcca gccagaaagt gagggagcca 45780
cggttgatga gagctttgtt gtaggtggac cagttggtga ttttgaactt ttgctttgcc 45840
acggaacggt ctgcgttgtc gggaagatgc gtgatctgat ccttcaactc agcaaaagtt 45900
cgatttattc aacaaagccg ccgtcccgtc aagtcagcgt aatgctctgc cagtgttaca 45960
accaattaac caattctgat tagaaaaact catcgagcat caaatgaaac tgcaatttat 46020
tcatatcagg attatcaata ccatattttt gaaaaagccg tttctgtaat gaaggagaaa 46080
actcaccgag gcagttccat aggatggcaa gatcctggta tcggtctgcg attccgactc 46140
gtccaacatc aatacaacct attaatttcc cctcgtcaaa aataaggtta tcaagtgaga 46200
aatcaccatg agtgacgact gaatccggtg agaatggcaa aagcttatgc atttctttcc 46260
agacttgttc aacaggccag ccattacgct cgtcatcaaa atcactcgca tcaaccaaac 46320
cgttattcat tcgtgattgc gcctgagcga gacgaaatac gcgatcgctg ttaaaaggac 46380
aattacaaac aggaatcgaa tgcaaccggc gcaggaacac tgccagcgca tcaacaatat 46440
tttcacctga atcaggatat tcttctaata cctggaatgc tgttttcccg gggatcgcag 46500
tggtgagtaa ccatgcatca tcaggagtac ggataaaatg cttgatggtc ggaagaggca 46560
taaattccgt cagccagttt agtctgacca tctcatctgt aacatcattg gcaacgctac 46620
ctttgccatg tttcagaaac aactctggcg catcgggctt cccatacaat cgatagattg 46680
tcgcacctga ttgcccgaca ttatcgcgag cccatttata cccatataaa tcagcatcca 46740
tgttggaatt taatcgcggc ctcgagcaag acgtttcccg ttgaatatgg ctcataacac 46800
cccttgtatt actgtttatg taagcagaca gttttattgt tcatgatgat atatttttat 46860
cttgtgcaat gtaacatcag agattttgag acacaacgtg gctttccccc cccccccctgc 46920
aggtcctgaa cggtctggtt ataggtacat tgagcaactg actgaaatgc ctcaaaatgt 46980
tctttacgat gccattggga tatatcaacg gtggtatatc cagtgatttt tttctccatt 47040
ttagcttcct tagctcctga aaatctcgat aactcaaaaa atacgcccgg tagtgatctt 47100
atttcattat ggtgaaagtt ggaacctctt acgtgccgat caacgtctca ttttcgccaa 47160
aagttggccc agggcttccc ggtatcaaca gggacaccag gatttattta ttctgcgaag 47220
tgatcttccg tcacaggtat ttattcgcga taagctcatg gagcggcgta accgtcgcac 47280
aggaaggaca gagaaagcgc ggatctggga agtgacggac agaacggtca ggacctggat 47340
tggggaggcg gttgccgccg ctgctgctga cggtgtgacg ttctctgttc cggtcacacc 47400
acatacgttc cgccattcct atgcgatgca catgctgtat gccggtatac cgctgaaagt 47460
tctgcaaagc ctgatgggac ataagtccat cagttcaacg gaagtctaca cgaaggtttt 47520
tgcgctggat gtggctgccc ggcaccgggt gcagtttgcg atgccggagt ctgatgcggt 47580
tgcgatgctg aaacaattat cctgagaata aatgccttgg cctttatatg gaaatgtgga 47640

actgagtgga tatgctgttt ttgtctgtta aacagagaag ctggctgtta tccactgaga 47700
agcgaacgaa acagtcggga aaatctccca ttatcgtaga gatccgcatt attaatctca 47760
ggagcctgtg tagcgtttat aggaagtagt gttctgtcat gatgcctgca agcggtaacg 47820
aaaacgattt gaatatgcct tcaggaacaa tagaaatctt cgtgcggtgt tacgttgaag 47880
tggagcggat tatgtcagca atggacagaa caacctaatg aacacagaac catgatgtgg 47940
tctgtccttt tacagccagt agtgctcgcc gcagtcgagc gacagggcga agccctcgag 48000
tgagcgagga agcaccaggg aacagcactt atatattctg cttacacacg atgcctgaaa 48060
aaacttccct tggggttatc cacttatcca cggggatatt tttataatta ttttttttat 48120
agtttttaga tcttcttttt tagagcgcct tgtaggcctt tatccatgct ggttctagag 48180
aaggtgttgt gacaaattgc cctttcagtg tgacaaatca ccctcaaatg acagtcctgt 48240
ctgtgacaaa ttgcccttaa ccctgtgaca aattgccctc agaagaagct gtttttttcac 48300
aaagttatcc ctgcttattg actctttttt atttagtgtg acaatctaaa aacttgtcac 48360
acttcacatg gatctgtcat ggcggaaaca gcggttatca atcacaagaa acgtaaaaat 48420
agcccgcgaa tcgtccagtc aaacgacctc actgaggcgg catatagtct ctcccgggat 48480
caaaaacgta tgctgtatct gttcgttgac cagatcagaa aatctgatgg caccctacag 48540
gaacatgacg gtatctgcga gatccatgtt gctaaatatg ctgaaatatt cggattgacc 48600
tctgcggaag ccagtaagga tatacggcag gcattgaaga gtttcgcggg gaaggaagtg 48660
gtttttatc gccctgaaga ggatgccggc gatgaaaaag gctatgaatc ttttccttgg 48720
tttatcaaac gtgcgcacag tccatccaga gggctttaca gtgtacatat caacccatat 48780
ctcattccct tctttatcgg gttacagaac cggtttacgc agtttcggct tagtgaaaca 48840
aaagaaatca ccaatccgta tgccatgcgt ttatacgaat ccctgtgtca gtatcgtaag 48900
ccggatggct caggcatcgt ctctctgaaa atcgactgga tcatagagcg ttaccagctg 48960
cctcaaagtt accagcgtat gcctgacttc cgccgccgct tcctgcaggt ctgtgttaat 49020
gagatcaaca gcagaactcc aatgcgcctc tcatacattg agaaaaagaa aggccgccag 49080
acgactcata tcgtattttc cttccgcgat atcacttcca tgacgacagg atagtctgag 49140
ggttatctgt cacagatttg agggtggttc gtcacatttg ttctgaccta ctgagggtaa 49200
tttgtcacag ttttgctgtt tccttcagcc tgcatggatt ttctcatact ttttgaactg 49260
taatttttaa ggaagccaaa tttgagggca gtttgtcaca gttgatttcc ttctctttcc 49320
cttcgtcatg tgacctgata tcgggggtta gttcgtcatc attgatgagg gttgattatc 49380
acagtttatt actctgaatt ggctatccgc gtgtgtacct ctacctggag tttttcccac 49440
ggtggatatt tcttcttgcg ctgagcgtaa gagctatctg acagaacagt tcttctttgc 49500
ttcctcgcca gttcgctcgc tatgctcggt tacacggctg cggcgagcgc tagtgataat 49560
aagtgactga ggtatgtgct cttcttatct ccttttgtag tgttgctctt attttaaaca 49620
actttgcggt tttttgatga ctttgcgatt ttgttgttgc tttgcagtaa attgcaagat 49680
ttaataaaaa aacgcaaagc aatgattaaa ggatgttcag aatgaaactc atggaaacac 49740
ttaaccagtg cataaacgct ggtcatgaaa tgacgaaggc tatcgccatt gcacagttta 49800
atgatgacag cccggaagcg aggaaaataa cccggcgctg gagaataggt gaagcagcgg 49860
atttagttgg ggtttcttct caggctatca gagatgccga gaaagcaggg cgactaccgc 49920
acccggatat ggaaattcga ggacgggttg agcaacgtgt tggttataca attgaacaaa 49980
ttaatcatat gcgtgatgtg tttggtacgc gattgcgacg tgctgaagac gtatttccac 50040
cggtgatcgg ggttgctgcc cataaaggtg gcgtttacaa aacctcagtt tctgttcatc 50100
ttgctcagga tctggctctg aaggggctac gtgttttgct cgtggaaggt aacgaccccc 50160
agggaacagc ctcaatgtat cacggatggg taccagatct tcatattcat gcagaagaca 50220
ctctcctgcc tttctatctt ggggaaaagg acgatgtcac ttatgcaata aagcccactt 50280
gctggccggg gcttgacatt attccttcct gtctggctct gcaccgtatt gaaactgagt 50340
taatgggcaa atttgatgaa ggtaaactgc ccaccgatcc acacctgatg ctccgactgg 50400
ccattgaaac tgttgctcat gactatgatg tcatagttat tgacagcgcg cctaacctgg 50460
gtatcggcac gattaatgtc gtatgtgctg ctgatgtgct gattgttccc acgcctgctg 50520
agttgtttga ctacacctcc gcactgcagt tttcgatat gcttcgtgat ctgctcaaga 50580
acgttgatct taaagggttc gagcctgatg tacgtatttt gcttaccaaa tacagcaata 50640
gtaatggctc tcagtccccg tggatggagg agcaaattcg ggatgcctgg ggaagcatgg 50700
ttctaaaaaa tgttgtacgt gaaacggatg aagttggtaa aggtcagatc cggatgagaa 50760
ctgtttttga acaggccatt gatcaacgct cttcaactgg tgcctggaga aatgctcttt 50820
ctatttggga acctgtctgc aatgaaattt tcgatcgtct gattaaacca cgctgggaga 50880
ttagataatg aagcgtgcgc ctgttattcc aaaacatacg ctcaatactc aaccggttga 50940
agatacttcg ttatcgacac cagctgcccc gatggtggat tcgttaattg cgcgcgtagg 51000
agtaatggct cgcggtaatg ccattacttt gcctgtatgt ggtcgggatg tgaagtttac 51060
tcttgaagtg ctccggggtg atagtgttga gaagacctct cgggtatggt caggtaatga 51120
acgtgaccag gagctgctta ctgaggacgc actggatgat ctcatccctt cttttctact 51180
gactggtcaa cagacaccgg cgttcggtcg aagagtatct ggtgtcatag aaattgccga 51240
tgggagtcgc cgtcgtaaag ctgctgcact taccgaaagt gattatcgtg ttctggttgg 51300
cgagctggat gatgagcaga tggctgcatt atccagattg ggtaacgatt atcgcccaac 51360
aagtgcttat gaacgtggtc agcgttatgc aagccgattg cagaatgaat ttgctggaaa 51420
tatttctgcg ctggctgatg cggaaaatat ttcacgtaag attattaccc gctgtatcaa 51480
caccgccaaa ttgcctaaat cagttgttgc tctttttttct caccccggtg aactatctgc 51540
ccggtcaggt gatgcacttc aaaaagcctt tacagataaa gaggaattac ttaagcagca 51600
ggcatctaac cttcatgagc agaaaaaagc tggggtgata tttgaagctg aagaagttat 51660
cactctttta acttctgtgc ttaaaacgtc atctgcatca agaactagtt taagctcacg 51720

acatcagttt gctcctggag cgacagtatt gtataagggc gataaaatgg tgcttaacct 51780
ggacaggtct cgtgttccaa ctgagtgtat agagaaaatt gaggccattc ttaaggaact 51840
tgaaaagcca gcaccctgat gcgaccacgt tttagtctac gtttatctgt ctttacttaa 51900
tgtcctttgt tacaggccag aaagcataac tggcctgaat attctctctg ggcccactgt 51960
tccacttgta tcgtcggtct gataatcaga ctgggaccac ggtcccactc gtatcgtcgg 52020
tctgattatt agtctgggac cacggtccca ctcgtatcgt cggtctgatt attagtctgg 52080
gaccacggtc ccactcgtat cgtcggtctg ataatcagac tgggaccacg gtcccactcg 52140
tatcgtcggt ctgattatta gtctgggacc atggtcccac tcgtatcgtc ggtctgatta 52200
ttagtctggg accacggtcc cactcgtatc gtcggtctga ttattagtct ggaaccacgg 52260
tcccactcgt atcgtcggtc tgattattag tctgggacca cggtcccact cgtatcgtcg 52320
gtctgattat tagtctggga ccacgatccc actcgtgttg tcggtctgat tatcggtctg 52380
ggaccacggt cccacttgta ttgtcgatca gactatcagc gtgagactac gattccatca 52440
atgcctgtca agggcaagta ttgacatgtc gtcgtaacct gtagaacgga gtaacctcgg 52500
tgtgcggttg tatgcctgct gtggattgct gctgtgtcct gcttatccac aacattttgc 52560
gcacggttat gtggacaaaa tacctggtta cccaggccgt gccggcacgt ttcctacaag 52620
gtagaatccg cctgagtcgc aagggtgact tcgcctatat tggacgacgg cgcgcagagg 52680
gcgacctctt tttgggttac gattgtagga ttatcactaa aacaatacat gaacatattc 52740
aaatggcaat ctctctaagg cattggaaat aaatacaaat aacagttggg tggagttttt 52800
cgacctgagg gcgttaactc ttcaaggaca acaagaccgt ggacgtcgag cggctctccg 52860
acaagcatgt cgcccgcctg gtcaagcaga ccgcactcgc cgccggcgct tcgataccgt 52920
tcgtattggt ccggcgaaac tgtgagtatc cgcatcgtaa tctccgcatg aacaggtcat 52980
gcgaacagaa atcatctcac ggtgcgtttg cctacgtgca gatttgcacc tcaggtgatt 53040
ctaccgagtc ggtgttccaa ggcgcgaaat gcgagcgggt gaggccgacc agacgccgac 53100
aaggttgtgc agatctgcac ttggtgccac gtcgcacaga agaagggaat cggtctaact 53160
cacagatagc atttgaagaa tcgggattta gtgtgatttc gattgaaacg cgcgtaaccg 53220
ttcattaacc aaaaacgtct tgcaacctca cccgcattag gtaatcgtca cggataaatg 53280
gcaatacgcg ccaattaacc gtgacaagag ataacaccgt gagcaaagcc gctgccatat 53340
cccgaaatga tcgcccgtcg gtagatgtta ccattggtga gcatgctgag cagctcagct 53400
ctcagcttca agcgatgagc gaggctttgt ttcctccgac gtcgcacaag agcttgcgca 53460
aattcacctc gggtgaagcc gcacgcttga tgaaaatatc tgactcaact cttcgaaaga 53520
tgacactggc tggcgaaggg ccgcaacctg aactcgccag caacggacgg cgcttttaca 53580
ccctcggtca gataaacgaa atccggcaga tgcttgccgg ctcgactcga ggacgtgaaa 53640
gcattgattt tgtgcctcat cgccgaggtt ctgagcattt gcaagtcgtt gctgtaacca 53700
acttcaaagg tggctctggg aagacgacga cgtccgctca tcttgcacag tatctggcgt 53760
tgcaaggtta cagggttctc gcagtcgatc tcgatccgca ggctagtctt tcagcactcc 53820
tcggcgttct gccagaaact gatgtcggtg caaacgaaac gctctatgcg gctattcggt 53880
acgacgacac acgtcgtccg ttgcgagatg tgatccgacc gacgtatttt gatggtcttc 53940
accttgttcc tggaaatctc gagcttatgg agttcgagca taccaccccg aaagcattga 54000
ctgacaaagg tacgcgcgac ggattgttct tcactcgcgt ggcccaagcc tttgatgagg 54060
tcgccgacga ttacgatgtc gtggtcatcg actgccctcc tcagcttggg tttttgactc 54120
tcagcgggtt gtgtgctgca acatcaatgg taatcaccgt acatcctcag atgctggata 54180
tcgcttccat gagccagttt ctcctcatga cacgcgacct tctgggtgtc gtgaaagagg 54240
cggggggcaa tctccagtac gatttcatac gctatctctt gacgcgctat gagccccagg 54300
acgcgccgca gacgaaagtg acggcactgc tgcgcaacat gttcgaggat cacgtcctta 54360
caaatcctat ggtcaagtcg gcagcggtat ctgatgccgg tttaaccaag cagacgctct 54420
atgagatagg gcgagagaac cttacgcgat cgacatacga ccgggcgatg gaatctttag 54480
atgcggtgaa ttcggagatc gaggctttga tcaagatggc gtgggggcgg gtctaatgaa 54540
aggctttgcg ttcctcacag atctgttggg agctcccaac agacaggtgt tgattcgccc 54600
cctggacatg gggcactgga gaagccgggg taatttgaga cgacgacgca cgcccatcgc 54660
taattggcca gggtgcagtt gtcttgtctt gttgggagct cccaaccaag cgcatttgca 54720
atcaaaaatg cgacgccacg acgccaaacc caagaggccg atatcatgag ccgcaaagac 54780
gcaatcgata ctttgttcct caagaagcaa cctgcgaccg atagagcagc agtcgacaag 54840
tcgaccgctc gtgttcgtac cggagcgatt tcggccatgg gttcgtcttt gcaagagatg 54900
gctgagggcg caaaggctgc agctcggctg caggatcaac tggctacagg cgaagccgtc 54960
gtgtccctgg atccatccat gatcgacggg tcgccgatcg cggatcggct gccctcagac 55020
gtggatccga aattcgagca gcttgaggcg agcatttcgc aggaggggca gcaggtgccg 55080
gttcttgtca gaccgcaccc tgaggctgcc ggtcgatatc agatcgtata tggaaggcgg 55140
cggctgcgcg cggcagtaaa tctgcggaga gaggtttctg ccattgttcg aaatctcacg 55200
gactgtgaac tggtcgtggc ccagggccgc gaaaatctta accgcgctga cctctcgttc 55260
attgagaagg ctctcttcgc cctgcgcctc gaagatgcgg gttttgatag agccaccatc 55320
attgccgcgc tatccactga caaggccgac ctcagccgct acataactgt agcaaggggc 55380
ataccgctga acctcgccac acaaatcggc ccagcgtcga aagcgggtcg atcgcgttgg 55440
gtcgtacttg ccgaggggct tgggaagcct aaggcaacgg acgcaatcga agcgatgctt 55500
gggtcagagc agttcaagca atctgatagc gatacccgct ttaacctcat tttcaacgcc 55560
gtttcaaggc cacctgcgaa gactccaaaa aaggtaaggg cctggagcac gccaaagggg 55620
aaaaaggcag cgacgatccg acaagaaact ggacgaacgg cgctggtttt cgacgagaga 55680
ctggtgccaa cttttggcga atatgtcgct gaccagttgg acagtctgta cgcccagttc 55740
attgaaacca acggaggagg caagctcgac caatagtcag ggtttcatcc aatttaaagc 55800

tccgctcgac tgagatggac tggctctcac cgcaaaagaa aaaggccccc gaaacggcgt 55860
tccggaagac cttctctgta gtctcgcagc taagagaatc gcatttccag gaatcgtagt 55920
caagggtccc gtaagggaaa gcgtcatttc gacgggcgga tttcaattgc ctaacaaaag 55980
gtaaaaggaa atgcagacgc atatctcaac gacgtccttt gggcggcggc cgatgacact 56040
cggccatatt gcaagccaga tggcagcaaa agcggtcgca tcagacactg tcgcccacaa 56100
atggcaggtc ttccagcaca tccgtgaatc ccggggactg atcggagcca cggaccgctc 56160
actctcgatc ctgaacgcgc tgttgacgtt ttacccggag accgccttga ctggtggtgc 56220
cgaactggtc gtatggcctt ctaacgaaca gctgatggct cgcgccaacg gcatgcccgc 56280
cacgacactg cgccggcatc ttgccatact ggttgattgc gggctcatca ttcgccgcga 56340
cagccccaat ggcaagcggt tcgcccgcaa gggaagggga ggggagattg agcaggccta 56400
tgggttcgat ctgtcgccga tcgtcgcgcg ggccgaggag ttccgagatc tggcccagac 56460
agtgcaagct gaaaaaaagg ccttccgggt ggccaaggag cgcttgactc ttcttcgtcg 56520
tgacattgtc aaaatgatcg aaactggcgt cgaagagagc gttcctggaa actggggaag 56580
agttacccag acctatcagg ggatcatcgg ccgcctgcca cgctcggcac ctcggcagct 56640
tgtcgagagt attgggcaag agcttcagga actctgcatc gagatccgtg acgtattgga 56700
atctttcaca aaaacgatga atctggacgc caatgagtcc catatcggtc gccacaaaca 56760
gaattcaaat ccagactcta aatttgaatc tgaatacagc tctggaaaaa aagatgaagc 56820
gggcggcagc gttgcggaaa ccgacaatgt acggagcttg ccgaaacgcg agctgccttt 56880
gggaatcgtg ctggatgcct gccccgaaat gcgggaattg gcccagggag gtccaattcg 56940
gcattggcgc gacttgctgg cggcggctga gcttgcccgg ccgatgctgg ggattagtcc 57000
gagcgcctgg cgggaggccc gcgaaaccat gggcgatcaa cacgcggcga tcacgctggc 57060
ttcgatctat cagcgggccg gtcagatcaa taacgctggg ggctatctgc gcagcctgac 57120
cgaccgggcc aaggatggga agttttcgac ctggccgatg gtcatggcgt tgctccgggc 57180
aaagctggac gagcagaaga atgcagttgg cgctggaaag ccgcgaactg ctgaggaggt 57240
cgaggatgac agccgcctcc acgtatcgga atcgctgctc aaaaacctgc gaaagccgag 57300
atcttggtga tcctctcgct attcagccgc ggcgatgtcg acgtcggtga tcaacccgga 57360
acgtcgggcg cggtcgatca ggttcttgac ggacgagggc gcccatttgg atccaccgcg 57420
cggcgtgcgc tcgtgcagtc tttcaagctg gccggcgatc tcgcggagct tcaggtctgg 57480
gttcgaagaa tggatgccgg ccacaagcgt catcaggcga tcttcgggaa gacggggagg 57540
agattttttc aggagcgctg catccaccag gcgttccgtc accatccact tcacggctcg 57600
gcgaagacgt tctggcgtcc agtcgaggcc ccgctgcttg agcattcggg cgatgtcgtc 57660
ccatgtgtga tccggtcgca tgcgacgaac ggtaggaagc cattggttcg cggacgcctg 57720
aatcctatcg ccatatgccg ctttctgggc cgcggtcatc cttgccagcg cctccgggcg 57780
cttttcccgg atgcccgggt tgccggaaag cttccctagg cacaaacgtt gactcttgga 57840
tcgagctggc agacaaagca ataacccaca cagaggacga ttaatggctg acgaagagat 57900
ccagaatccg ccggacggta ctgctgctgc cgaagttgag ccggctgctc ctagaggtag 57960
aagagcaaag aaagcaccag ccgaaacagc ccgcacggga tcgttcaaat ccgtgaagcc 58020
gaaaacccgc ggcctcagca accgagaaaa actggagaag atcggtcaaa tcgaagctca 58080
ggtcgctggc ggcgcaacct tgaaggacgc cgttaagatc gtgggtattt ccgttcagac 58140
ctattatcaa tggaagagag ctgcggttca acctgtctca cagaatccgg ccgtgtctgt 58200
ttcagttgac gatgaactcg gcgagttcat ccaactcgag gaggaaaatc ggcggctcag 58260
aaagcttcac gctgccgcaa gcactcaggg cgcaagggct gctaaaggaa gcggaacacg 58320
tagaaagcca gtccgcagaa acggtgctga ccccggatga atgtcagcta ctgggctatc 58380
tggacaaggg aaaacgcaag cgcaaagaga aagcaggtag cttgcagtgg gcttacatgg 58440
cgatagctag actgggcggt tttatggaca gcaagcgaac cggaattgcc agctggggcg 58500
ccctctggga aggttgggaa gccctgcaaa gtaaactgga tggctttctt gccgccaagg 58560
atctgatggc gcaggggatc aagatctgat caagagacag gggccggccc acgctgtcgt 58620
ccaatctccc aagacacgcc gccaccgcgc accgtcgcgg cgagctgctc cccaagccgc 58680
tgttcgatgg gcttccaccg cacgaggctg gaccccttgg cgtcatcaag catcccattt 58740
cgcccgctgg cgagcatgac ggggcgccgg tagacgccgg caacgcgctg gccgtcggcc 58800
acggggcgat gctccaggcc ggtatcggcg gcaatgtcct tcgcggcctg cgccagttcc 58860
cgagcccgct gctgcccagc agattccggt gaggatcacg cgctgcccgc gccgctcggc 58920
cagtccctgt tcggccagga agtccgcgcg ctgctgtatc gcctacttgg cctcactgct 58980
aaagcccagg tcgcccaagc ccgagccacc gtcgatcaac tgctggtcaa gccaggtggc 59040
accgatcacg cgggcctgcc gctcgatggg caggtgcgat ttcagctcca ccgtcacgcc 59100
accaagacgc tgggcgtcat agcggcggcc ctgctcgggc agatcgtccg gcaccttcca 59160
tagtccctcg gccacgcaca ccacgatgcc ggcctggtgc agggcttcga ggcggcgggt 59220
gtggcccgca acgacttcca gcggatcacg cccgacacgg cctgacctag ctcgacgacc 59280
aggtgagatc ggtgaccgcg ctagtcaagc aaccggcgtg ccatggcgtt tacggccaga 59340
tcaatcgcag cgccctcgcc ctcgccgtcg ccgtcgccga tgaaccaggc tgccgacaag 59400
cccgtccatg caatgatcca gcgaagaagc cgttcgggct caaacccggt cgtcgcgacc 59460
acaatgctga gtcgagcctc cagcctgccc ggcaggatcg caagcgggcg accggggtcg 59520
ctgagatcgg gattcgtgaa gatgttggca tagtcgaagg tgcgctcgcc gagcagtccg 59580
tgcgggtcga tggccagcca gccgcggtcg ccgaagtcga gcacgttctc gtggtgcagg 59640
tcgccgtgga gcgggcacac ctcgcgcggc gccgccagaa gttggcgcgc tacgctggcg 59700
gcgggcgcaa gtgccgcgtg ctcagcggcc aaccggaaaa gcggctggaa ccattcctgt 59760
agcggatgga gatcgggcgg cggtccggac cgcggcgcgt gcagacgagc ggcggtgtcg 59820
cagaggatcg tggcatcacc gaaccgcgcc gtgcgcgggt cgtcggtgag ccagagtttc 59880

agcaggccgc ccaggcggcc caggtcgcca ttgatgcggg ccagctcgcg gacgtgctca 59940
tagtccacga cgcccgtgat tttgtagccc tggccgacgg ccagcaggta ggccgacagg 60000
ctcatgccgg ccgccgccgc cttttcctca atcgctcttc gttcgtctgg aaggcagtac 60060
accttgatag gtgggctgcc cttcctggtt ggcttggttt catcagccat ccgcttgccc 60120
tcatctgtta cgccggcggt agccggccag cctcgcagag caggattccc gttgagcacc 60180
gccaggtgcg aataagggac agtgaagaag gaacacccgc tcgcgggtgg gcctacttca 60240
cctatcctgc ccggctgacg ccgttggata caccaaggaa agtctacacg aaccctttgg 60300
caaaatcctg tatatcgtgc gaaaaaggat ggatataccg aaaaaatcgc tataatgacc 60360
ccgaagcagg gttatgcagc ggaaaagcgc tgcttccctg ctgttttgtg gaatatctac 60420
cgactggaaa caggcaaatg caggaaatta ctgaactgag gggacaggcg agagacgatg 60480
ccaaagagct acaccgacga gctggccgag tgggttgaat cccgcgcggc caagaagcgc 60540
cggcgtgatg aggctgcggt tgcgttcctg gcggtgaggg cggatgtcga ggcggcgtta 60600
gcgtccggct atgcgctcgt caccatttgg gagcacatgc gggaaacggg gaaggtcaag 60660
ttctcctacg agacgttccg ctcgcacgcc aggcggcaca tcaaggccaa gcccgccgat 60720
gtgcccgcac cgcaggccaa ggctgcggaa cccgcgccgg cacccaagac gccggagcca 60780
cggcggccga agcagggggg caaggctgaa aagccggccc ccgctgcggc cccgaccggc 60840
ttcaccttca acccaacacc ggacaaaaag gatcaaccgg gctgcatccg atgcaagtgt 60900
gtcgctgtcg actcgttgta caacgaaatc cattcccatt ccgcgctcaa gatggcttcc 60960
cctcggcagt tcatcagggc taaatcaatc tagccgactt gtccggtgaa atgggctgca 61020
ctccaacaga aacaatcaaa caaacataca cagcgactta ttcacacgag ctcaaattac 61080
aacggtatat at 61092

<210> 5
<211> 26802
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 5
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc 240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa 300
gcttggccac taaggccaat ttcgcgccct gcagcaaatt tacacattgc cactaaacgt 360
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa 420
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag 480
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa 540
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa 600
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac 660
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa 720
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt 780
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca 840
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac 900
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc 960
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtactgttta 1020
agcttcactg tctctgaatc ggcaaaggta aacgtatcaa ttattctaca aaccctttta 1080
tttttctttt gaattaccgt cttcattggt tatatgataa cttgataagt aaagcttcaa 1140
taattgaatt tgatctgtgt ttttttggcc ttaatactaa atccttacat aagctttgtt 1200
gcttctcctc ttgtgagttg agtgttaagt tgtaataatg gttcactttc agctttagaa 1260
gaaaccatgg aagttgttga gaggttctac ggagagttgg atggaaaggt ttcccaagga 1320
gtgaacgctt tgttgggatc tttcggagtt gagttgactg ataccccaac tactaaggga 1380
ttgccactcg ttgattctcc aactccaatt gtgttgggag tgtctgttta cttgaccatc 1440
gtgatcggag gattgctttg gatcaaggct agagatctca agccaagagc ttctgagcca 1500
ttcttgttgc aagctttggt gttggtgcac aacttgttct gcttcgcttt gtctctttac 1560
atgtgcgtgg gtatcgctta ccaagctatc acctggagat attccttgtg gggaaacgct 1620
tataacccaa agcacaagga gatggctatc ctcgtttacc tcttctacat gtccaagtac 1680
gtggagttca tggataccgt gatcatgatc ctcaagagat ccaccagaca gatttctttc 1740
ctccacgtgt accaccactc ttctatctcc cttatctggt gggctattgc tcaccacgct 1800
ccaggaggag aggcttattg gagtgctgct ctcaactctg gagtgcacgt gttgatgtac 1860
gcttactact tcttggctgc ttgcttgaga tcttccccaa agctcaagaa caagtacctc 1920
ttctggggaa gatacctcac ccaattccag atgttccagt tcatgctcaa cttggtgcaa 1980
gcttactacg atatgaaaac caacgctcca tatccacaat ggctcatcaa gatcctcttc 2040
tactacatga tctccctctt gttcctcttc ggaaacttct acgtgcaaaa gtacatcaag 2100
ccatccgatg gaaagcaaaa gggagctaag accgagtgat cgacaagctc gagtttctcc 2160
ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg gtttcgctca 2220

tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata cttctatcaa 2280
taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc ccgaattaat 2340
tcggcgttaa ttcagggccg gccaaagtag gcgcctacta ccggtaattc ccgggattag 2400
cggccgctag tctgtgcgca cttgtatcct gcaggttagg ccggccatta gcagatattt 2460
ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg 2520
gacaacgttg ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca 2580
tgagttgcaa attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg 2640
agagagtctt tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag 2700
tctttttggt gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag 2760
gctgtaaaag attgtaaaag actattttgg tgttttggat aaaatgatag tttttataga 2820
ttcttttgct tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg 2880
aaatcgattg aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt 2940
ctctccattt ttatacctat ttaaccgtaa tcgattctaa tagatgatcg atttttttata 3000
taatcctaat taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat 3060
agaatcagta ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt 3120
tttaattttt ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc 3180
aaggtaagag aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa 3240
atgtacactt gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt 3300
attaaaatac cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa 3360
aagaacccac gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac 3420
tatataaacc caccatcccc aatctcacca aacccaccac acaactcaca actcactctc 3480
acaccttaaa gaaccaatca ccaccaaaaa atttcacgat ttggaatttg attcctgcga 3540
tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt ctttgtgatg 3600
ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga 3660
aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca tgttctttgt 3720
tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt cttactgatc 3780
gttattagga gtttggggaa aaaggaagag tttttttggt tggttcgagt gattatgagg 3840
ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac catgggaaaa 3900
ggatctgagg gaagatctgc tgctagagag atgactgctg aggctaacgg agataagaga 3960
aagaccatcc tcattgaggg agtgttgtac gatgctacca acttcaaaca cccaggaggt 4020
tccattatta acttcctcac cgagggagaa gctggagttg atgctaccca agcttacaga 4080
gagttccatc agagatccgg aaaggctgat aagtacctca agtccctccc aaagttggat 4140
gcttctaagg tggagtctag gttctctgct aaggagcagg ctagaaggga cgctatgacc 4200
agggattacg ctgctttcag agaggagttg gttgctgagg gatacttcga tccatctatc 4260
ccacacatga tctacagagt ggtggagatt gtggctttgt tcgctttgtc tttctggttg 4320
atgtctaagg cttctccaac ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa 4380
ggaagatgcg gatgggttat gcacgagatg ggacacggat ctttcactgg agttatctgg 4440
ctcgatgata ggatgtgcga gttcttctac ggagttggat gtggaatgtc tggacactac 4500
tggaagaacc agcactctaa gcaccacgct gctccaaaca gattggagca cgatgtggat 4560
ttgaacacct tgccactcgt tgctttcaac gagagagttg tgaggaaggt taagccagga 4620
tctttgttgg ctttgtggct cagagttcag gcttatttgt tcgctccagt gtcttgcttg 4680
ttgatcggat tgggatggac cttgtacttg cacccaagat atatgctcag gaccaagaga 4740
cacatggagt ttgtgtggat cttcgctaga tatatcggat ggttctcctt gatgggagct 4800
ttgggatatt ctcctggaac ttctgtggga atgtacctct gctctttcgg acttggatgc 4860
atctacatct tcctccaatt cgctgtgtct cacacccact tgccagttac caacccagag 4920
gatcaattgc actggcttga gtacgctgct gatcacaccg tgaacatctc taccaagtct 4980
tggttggtta cctggtggat gtctaacctc aacttccaaa tcgagcacca cttgttccca 5040
accgctccac aattcaggtt caaggagatc tctccaagag ttgaggctct cttcaagaga 5100
cacaacctcc cttactacga tttgccatac acctctgctg tttctactac cttcgctaac 5160
ctctactctg ttggacactc tgttggagct gataccaaga agcaggattg actgctttaa 5220
tgagatatgc gagacgccta tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt 5280
gtaaaaaacc tgagcatgtg tagctcagat ccttaccgcc ggtttcggtt cattctaatg 5340
aatatatcac ccgttactat cgtattttta tgaataatat tctccgttca atttactgat 5400
tgtgtcgacg cgatcgcgtg caaacactgt acggaccgtg gcctaatagg ccggtaccca 5460
agtttgtaca aaaaagcagg ctccatgatt acgccaagct tggccactaa ggccaattta 5520
aatctactag gccggccatc gacggcccgg actgtatcca acttctgatc tttgaatctc 5580
tctgttccaa catgttctga aggagttcta agacttttca gaaagcttgt aacatgcttt 5640
gtagactttc tttgaattac tcttgcaaac tctgattgaa cctacgtgaa aactgctcca 5700
gaagttctaa ccaaattccg tcttgggaag gcccaaaatt tattgagtac ttcagtttca 5760
tggacgtgtc ttcaaagatt tataacttga aatcccatca tttttaagag aagttctgtt 5820
ccgcaatgtc ttagatctca ttgaaatcta caactcttgt gtcagaagtt cttccagaat 5880
caacttgcat catggtgaaa atctggccag aagttctgaa cttgtcatat ttcttaacag 5940
ttagaaaaat ttctaagtgt ttagaatttt gacttttcca aagcaaactt gacttttgac 6000
tttcttaata aaacaaactt catattctaa catgtcttga tgaaatgtga ttcttgaaat 6060
ttgatgttga tgcaaaagtc aaagtttgac ttttcagtgt gcaattgacc attttgctct 6120
tgtgccaatt ccaaacctaa attgatgtat cagtgctgca aacttgatgt catggaagat 6180
cttatgagaa aattcttgaa gactgagagg aaaaatttg tagtacaaca caaagaatcc 6240
tgtttttcat agtcggacta gacacattaa cataaaacac cacttcattc gaagagtgat 6300

tgaagaagga aatgtgcagt tacctttctg cagttcataa gagcaactta cagacacttt 6360
tactaaaata ctacaaagag gaagatttta acaacttaga gaagtaatgg gagttaaaga 6420
gcaacacatt aagggggagt gttaaaatta atgtgttgta accaccacta cctttagtaa 6480
gtattataag aaaattgtaa tcatcacatt ataattattg tccttattta aaattatgat 6540
aaagttgtat cattaagatt gagaaaacca aatagtcctc gtcttgattt ttgaattatt 6600
gttttctatg ttacttttct tcaagcctat ataaaaactt tgtaatgcta aattgtatgc 6660
tggaaaaaaa tgtgtaatga attgaataga aattatggta tttcaaagtc caaaatccat 6720
caatagaaat ttagtacaaa acgtaactca aaaatattct cttattttaa attttacaac 6780
aatataaaaa tattctctta ttttaaattt tacaataata taatttatca cctgtcacct 6840
ttagaatacc accaacaata ttaatactta gatattttat tcttaataat tttgagatct 6900
ctcaatatat ctgatattta ttttatattt gtgtcatatt ttcttatgtt ttagagttaa 6960
cccttatatc ttggtcaaac tagtaattca atatatgagt ttgtgaagga cacattgaca 7020
tcttgaaaca ttggttttaa ccttgttgga atgttaaagg taataaaaca ttcagaatta 7080
tgaccatcta ttaatatact tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat 7140
ggtaagctag agtgtcttgc tggcctgtgt atatcaattc catttccaga tggtagaaac 7200
tgccactacg aataattagt cataagacac gtatgttaac acacgtcccc ttgcatgttt 7260
tttgccatat attccgtctc tttctttttc ttcacgtata aaacaatgaa ctaattaata 7320
gagcgatcaa gctgaacagt tctttgcttt cgaagttgcc gcaacctaaa caggtttttc 7380
cttcttcttt cttcttatta actacgacct tgtcctttgc ctatgtaaaa ttactaggtt 7440
ttcatcagtt acactgatta agttcgttat agtggaagat aaaatgccct caaagcattt 7500
tgcaggatat ctttgatttt tcaaagatat ggaactgtag agtttgatag tgttcttgaa 7560
tgtggttgca tgaagttttt ttggtctgca tgttattttt tcctcgaaat atgttttgag 7620
tccaacaagt gattcacttg ggattcagaa agttgttttc tcaatatgta acagtttttt 7680
tctatggaga aaaatcatag ggaccgttgg ttttggcttc tttaattttg agctcagatt 7740
aaacccattt tacccggtgt tcttggcaga attgaaaaca gtacgtagta ccgcgcctac 7800
catgtgtgtt gagaccgaga acaacgatgg aatccctact gtggagatcg ctttcgatgg 7860
agagagagaa agagctgagg ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc 7920
tttggctaag accttcgcta gaagatacgt ggttatcgag ggagttgagt acgatgtgac 7980
cgatttcaaa catcctggag gaaccgtgat tttctacgct ctctctaaca ctggagctga 8040
tgctactgag gctttcaagg agttccacca cagatctaga aaggctagga aggctttggc 8100
tgctttgcct tctagacctg ctaagaccgc taaagtggat gatgctgaga tgctccagga 8160
tttcgctaag tggagaaagg agttggagag ggacggattc ttcaagcctt ctcctgctca 8220
tgttgcttac agattcgctg agttggctgc tatgtacgct ttgggaacct acttgatgta 8280
cgctagatac gttgtgtcct ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg 8340
atgggttcaa cacgagggag gacactcttc tttgaccgga aacatctggt gggataagag 8400
aatccaagct ttcactgctg gattcggatt ggctggatct ggagatatgt ggaactccat 8460
gcacaacaag caccacgcta ctcctcaaaa agtgaggcac gatatggatt tggataccac 8520
tcctgctgtt gctttcttca acaccgctgt ggaggataat agacctaggg gattctctaa 8580
gtactggctc agattgcaag cttggacctt cattcctgtg acttctggat tggtgttgct 8640
cttctggatg ttcttcctcc acccttctaa ggctttgaag ggaggaaagt acgaggagct 8700
tgtgtggatg ttggctgctc acgtgattag aacctggacc attaaggctg ttactggatt 8760
caccgctatg caatcctacg gactcttctt ggctacttct tgggtttccg gatgctactt 8820
gttcgctcac ttctctactt ctcacaccca cttggatgtt gttcctgctg atgagcactt 8880
gtcttgggtt aggtacgctg tggatcacac cattgatatc gatccttctc agggatgggt 8940
taactggttg atgggatact tgaactgcca agtgattcac cacctcttcc cttctatgcc 9000
tcaattcaga caacctgagg tgtccagaag attcgttgct ttcgctaaga agtggaacct 9060
caactacaag gtgatgactt atgctggagc ttggaaggct actttgggaa acctcgataa 9120
tgtgggaaag cactactacg tgcacggaca acactctgga aagaccgctt gattaattaa 9180
ggccgcctcg accgtacccc ctgcagatag actatactat gttttagcct gcctgctggc 9240
tagctactat gttatgttat gttgtaaaat aaacacctgc taaggtatat ctatctatat 9300
tttagcatgg ctttctcaat aaattgtctt tccttatcgt ttactatctt atacctaata 9360
atgaaataat aatatcacat atgaggaacg gggcaggttt aggcatatat atacgagtgt 9420
agggcggagt gggggggcgcc tactaccggt aattcccggg attagcggcc gctagtctgt 9480
gcgcacttgt atcctgcagg ttaggccggc cacacgggca ggacataggg actactacaa 9540
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa 9600
agtgctagag gggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca 9660
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg 9720
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa 9780
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat 9840
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc 9900
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag 9960
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata 10020
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag 10080
atttgtgcat tttgttgaat ataaattgac aatttttttt atttaattat agattattta 10140
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt 10200
aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca 10260
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt 10320
taatcgggta aaacctgatt actaaatata tatttttat ttgataaaca aaacaaaaat 10380

gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt 10440
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat 10500
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag 10560
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact 10620
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac 10680
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga 10740
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt 10800
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt 10860
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact 10920
tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata 10980
tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg 11040
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta 11100
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc 11160
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc 11220
gacattttta tcataaatct ggtgcttaaa cactctggtg agttctagta cttctgctat 11280
gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt tcttgatttt 11340
tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt ttttttgtg 11400
gttaatttag tttcctatgt tcttcgattg tattatgcat gatctgtgtt tggattctgt 11460
tagattatgt attggtgaat atgtatgtgt ttttgcatgt ctggttttgg tcttaaaaat 11520
gttcaaatct gatgatttga ttgaagcttt tttagtgttg gtttgattct tctcaaaact 11580
actgttaatt tactatcatg ttttccaact ttgattcatg atgacacttt tgttctgctt 11640
tgttataaaa ttttggttgg tttgattttg taattatagt gtaattttgt taggaatgaa 11700
catgttttaa tactctgttt tcgatttgtc acacattcga attattaatc gataatttaa 11760
ctgaaaattc atggttctag atcttgttgt catcagatta tttgtttcga taattcatca 11820
aatatgtagt ccttttgctg atttgcgact gtttcatttt ttctcaaaat tgttttttgt 11880
taagtttatc taacagttat cgttgtcaaa agtctctttc attttgcaaa atcttctttt 11940
tttttttgtt tgtaactttg ttttttaagc tacacattta gtctgtaaaa tagcatcgag 12000
gaacagttgt cttagtagac ttgcatgttc ttgtaacttc tatttgtttc agtttgttga 12060
tgactgcttt gattttgtag gtcaaaggcg cgccctacca tggatgctta taacgctgct 12120
atggataaga ttggagctgc tatcatcgat tggagtgatc cagatggaaa gttcagagct 12180
gatagggagg attggtggtt gtgcgatttc agatccgcta tcaccattgc tctcatctac 12240
atcgctttcg tgatcttggg atctgctgtg atgcaatctc tcccagctat ggacccatac 12300
cctatcaagt tcctctacaa cgtgtctcaa atcttcctct gcgcttacat gactgttgag 12360
gctggattcc tcgcttatag gaacggatac accgttatgc catgcaacca cttcaacgtg 12420
aacgatccac cagttgctaa cttgctctgg ctcttctaca tctccaaagt gtgggatttc 12480
tgggatacca tcttcattgt gctcggaaag aagtggagac aactctcttt cttgcacgtg 12540
taccaccaca ccaccatctt cctcttctac tggttgaacg ctaacgtgct ctacgatgga 12600
gatatcttct tgaccatcct cctcaacgga ttcattcaca ccgtgatgta cacctactac 12660
ttcatctgca tgcacaccaa ggattctaag accggaaagt ctttgccaat ctggtggaag 12720
tcatctttga ccgctttcca actcttgcaa ttcaccatca tgatgtccca agctacctac 12780
ttggttttcc acggatgcga taaggtttcc ctcagaatca ccatcgtgta cttcgtgtac 12840
attctctccc ttttcttcct cttcgctcag ttcttcgtgc aatcctacat ggctccaaag 12900
aagaagaagt ccgcttgatg ttaattaagg ccgcagatat cagatctggt cgacctagag 12960
gatccccggc cgcaaagata ataacaaaag cctactatat aacgtacatg caagtattgt 13020
atgatattaa tgtttttacg tacgtgtaaa caaaaataat tacgtttgta acgtatggtg 13080
atgatgtggt gcactaggtg taggccttgt attaataaaa agaagtttgt tctatataga 13140
gtggtttagt acgacgattt atttactagt cggattggaa tagagaaccg aattcttcaa 13200
tccttgcttt tgatcaagaa ttgaaaccga atcaaatgta aaagttgata tatttgaaaa 13260
acgtattgag cttatgaaaa tgctaatact ctcatctgta tggaaaagtg actttaaaac 13320
cgaacttaaa agtgacaaaa ggggaatatc gcatcaaacc gaatgaaacc gatggcgcct 13380
accggtatcg gtccgattgc ggccgcttaa agggcgaatt cgtttaaaca ctgtacggac 13440
cgtggcctaa taggccggta ccacccagct ttcttgtaca aagtggccat gattacgcca 13500
agcttggcca ctaaggccaa tttaaatcta ctaggccggc cataaggatg acctacccat 13560
tcttgagaca aatgttacat tttagtatca gagtaaaatg tgtacctata actcaaattc 13620
gattgacatg tatccattca acataaaatt aaaccagcct gcacctgcat ccacatttca 13680
agtattttca aaccgttcgg ctcctatcca ccgggtgtaa caagacggat tccgaatttg 13740
gaagattttg actcaaattc ccaatttata ttgaccgtga ctaaatcaac tttaacttct 13800
ataattctga ttaagctccc aatttatatt cccaacggca ctacctccaa aatttataga 13860
ctctcatccc cttttaaacc aacttagtaa acgttttttt tttaatttta tgaagttaag 13920
tttttacctt gtttttaaaa agaatcgttc ataagatgcc atgccagaac attagctaca 13980
cgttacacat agcatgcagc cgcggagaat tgtttttctt cgccacttgt cactcccttc 14040
aaacacctaa gagcttctct ctcacagcac acacatacaa tcacatgcgt gcatgcatta 14100
ttacacgtga tcgccatgca aatctccttt atagcctata aattaactca tcggcttcac 14160
tctttactca aaccaaaact catcaataca aacaagatta aaaacatttc acgatttgga 14220
atttgattcc tgcgatcaca ggtatgacag gttagatttt gttttgtata gttgtataca 14280
tacttctttg tgatgttttg tttacttaat cgaatttttg gagtgtttta aggtctctcg 14340
tttagaaatc gtggaaaata tcactgtgtg tgtgttctta tgattcacag tgtttatggg 14400
tttcatgttc tttgttttat cattgaatgg gaagaaattt cgttgggata caaatttctc 14460

atgttcttac tgatcgttat taggagtttg gggaaaaagg aagagttttt ttggttggtt 14520
cgagtgatta tgaggttatt tctgtatttg atttatgagt taatggtcgt tttaatgttg 14580
tagaccgcca tggctatttt gaaccctgag gctgattctg ctgctaacct cgctactgat 14640
tctgaggcta agcaaagaca attggctgag gctggataca ctcatgttga gggtgctcct 14700
gctcctttgc ctttggagtt gcctcatttc tctctcagag atctcagagc tgctattcct 14760
aagcactgct tcgagagatc tttcgtgacc tccacctact acatgatcaa gaacgtgttg 14820
acttgcgctg ctttgttcta cgctgctacc ttcattgata gagctggagc tgctgcttat 14880
gttttgtggc ctgtgtactg gttcttccag ggatcttact tgactggagt gtgggttatc 14940
gctcatgagt gtggacatca ggcttattgc tcttctgagg tggtgaacaa cttgattgga 15000
ctcgtgttgc attctgcttt gttggtgcct taccactctt ggagaatctc tcacagaaag 15060
caccattcca acactggatc ttgcgagaac gatgaggttt tcgttcctgt gaccagatct 15120
gtgttggctt cttcttggaa cgagaccttg gaggattctc ctctctacca actctaccgt 15180
atcgtgtaca tgttggttgt tggatggatg cctggatacc tcttcttcaa cgctactgga 15240
cctactaagt actggggaaa gtctaggtct cacttcaacc cttactccgc tatctatgct 15300
gatagggaga gatggatgat cgtgctctcc gatattttct tggtggctat gttggctgtt 15360
ttggctgctt tggtgcacac tttctccttc aacaccatgg tgaagttcta cgtggtgcct 15420
tacttcattg tgaacgctta cttggtgttg attacctacc tccaacacac cgatacctac 15480
atccctcatt tcagagaggg agagtggaat tggttgagag gagctttgtg cactgtggat 15540
agatcatttg gtccattcct cgattctgtg gtgcatagaa tcgtggatac ccatgtttgc 15600
caccacatct tctccaagat gcctttctat cattgcgagg aggctaccaa cgctattaag 15660
cctctcctcg gaaagttcta cttgaaggat accactcctg ttcctgttgc tctctggaga 15720
tcttacaccc attgcaagtt cgttgaggat gatggaaagg tggtgttcta caagaacaag 15780
ctctagttaa ttaataattg attggttcga gtattatggc attgggaaaa ctgtttttct 15840
tgtaccattt gttgtgcttg taatttactg tgttttttat tcggttttcg ctatcgaact 15900
gtgaaatgga aatggatgga gaagagttaa tgaatgatat ggtccttttg ttcattctca 15960
aattaatatt atttgttttt tctcttattt gttgtgtgtt gaatttgaaa ttataagaga 16020
tatgcaaaca ttttgttttg agtaaaaatg tgtcaaatcg tggcctctaa tgaccgaagt 16080
taatatgagg agtaaaacac ttgtagttgt accattatgc ttattcacta ggcaacaaat 16140
atattttcag acctagaaaa gctgcaaatg ttactgaata caagtatgtc ctcttgtgtt 16200
ttagacattt atgaactttc ctttatgtaa ttttccagaa tccttgtcag attctaatca 16260
ttgctttata attatagtta tactcatgga tttgtagttg agtatgaaaa tattttttaa 16320
tgcattttat gacttgccaa ttgattgaca acatgcatca atggcgccta ctaccggtaa 16380
ttcccgggat tagcggccgc tagtctgtgc gcacttgtat cctgcaggtc aatcgtttaa 16440
acactgtacg gaccgtggcc taataggccg gtacccaact ttattataca tagttgataa 16500
ttcactggcc ggatgtaccg aattcgcggc cgcaagcttg tacactagta cgcgtcaatt 16560
ggcgatcgcg gatctgagat gaaaccggtg attatcagaa ccttttatgg tctttgtatg 16620
catatggtaa aaaaacttag tttgcaattt cctgtttgtt ttggtaattt gagtttcttt 16680
tagttgttga tctgcctgct ttttggttta cgtcagacta ctactgctgt tgttgtttgg 16740
tttcctttct ttcattttat aaataaataa tccggttcgg tttactcctt gtgactggct 16800
cagtttggtt attgcgaaat gcgaatggta aattgagtaa ttgaaattcg ttattagggt 16860
tctaagctgt tttaacagtc actgggttaa tatctctcga atcttgcatg gaaaatgctc 16920
ttaccattgg tttttaattg aaatgtgctc atatgggccg tggtttccaa attaaataaa 16980
actacgatgt catcgagaag taaaatcaac tgtgtccaca ttatcagttt tgtgtatacg 17040
atgaaatagg gtaattcaaa atctagcttg atatgccttt tggttcattt taaccttctg 17100
taaacatttt ttcagatttt gaacaagtaa atccaaaaaa aaaaaaaaaa aatctcaact 17160
caacactaaa ttattttaat gtataaaaga tgcttaaaac atttggctta aaagaaagaa 17220
gctaaaaaca tagagaactc ttgtaaattg aagtatgaaa atatactgaa ttgggtatta 17280
tatgaatttt tctgatttag gattcacatg atccaaaaag gaaatccaga agcactaatc 17340
agacattgga agtaggaata tttcaaaaag tttttttttt taagtaagtg acaaaagctt 17400
ttaaaaaata gaaaagaaac tagtattaaa gttgtaaatt taataaacaa aagaaatttt 17460
ttatattttt tcatttcttt ttccagcatg aggttatgat ggcaggatgt ggatttcatt 17520
tttttccttt tgatagcctt ttaattgatc tattataatt gacgaaaaaa tattagttaa 17580
ttatagatat atttaggta gtattagcaa tttacacttc caaaagacta tgtaagttgt 17640
aaatatgatg cgttgatctc ttcatcattc aatggttagt caaaaaaata aaagcttaac 17700
tagtaaacta aagtagtcaa aaattgtact ttagtttaaa atattacatg aataatccaa 17760
aacgacattt atgtgaaaca aaaacaatat agatccatta ccctgttatc cctagagggg 17820
aaaattcgaa tccaaaaatt acggatatga atataggcat atccgtatcc gaattatccg 17880
tttgacagct agcaacgatt gtacaattgc ttctttaaaa aaggaagaaa gaaagaaaga 17940
aaagaatcaa catcagcgtt aacaaacggc cccgttacgg cccaaacggt catatagagt 18000
aacggcgtta agcgttgaaa gactcctatc gaaatacgta accgcaaacg tgtcatagtc 18060
agatcccctc ttccttcacc gcctcaaaca caaaaataat cttctacagc ctatatatac 18120
aacccccccct tctatctctc ctttctcaca attcatcatc tttctttctc tacccccaat 18180
tttaagaaat cctctcttct cctcttcatt ttcaaggtaa atctctctct ctctctctct 18240
ctctgttatt ccttgtttta attaggtatg tattattgct agtttgttaa tctgcttatc 18300
ttatgtatgc cttatgtgaa tatctttatc ttgttcatct catccgttta gaagctataa 18360
atttgttgat ttgactgtgt atctacacgt ggttatgttt atatctaatc agatatgaat 18420
ttcttcatat tgttgcgttt gtgtgtacca atccgaaatc gttgattttt ttcatttaat 18480
cgtgtagcta attgtacgta tacatatgga tctacgtatc aattgttcat ctgtttgtgt 18540

ttgtatgtat acagatctga aaacatcact tctctcatct gattgtgttg ttacatacat 18600
agatatagat ctgttatatc atttttttta ttaattgtgt atatatatat gtgcatagat 18660
ctggattaca tgattgtgat tatttacatg attttgttat ttacgtatgt atatatgtag 18720
atctggactt tttggagttg ttgacttgat tgtatttgtg tgtgtatatg tgtgttctga 18780
tcttgatatg ttatgtatgt gcagctgaac catggcggcg gcaacaacaa caacaacaac 18840
atcttcttcg atctccttct ccaccaaacc atctccttcc tcctccaaat caccattacc 18900
aatctccaga ttctccctcc cattctccct aaaccccaac aaatcatcct cctcctcccg 18960
ccgccgcggt atcaaatcca gctctccctc ctccatctcc gccgtgctca acacaaccac 19020
caatgtcaca accactccct ctccaaccaa acctaccaaa cccgaaacat tcatctcccg 19080
attcgctcca gatcaacccc gcaaaggcgc tgatatcctc gtcgaagctt tagaacgtca 19140
aggcgtagaa accgtattcg cttaccctgg aggtacatca atggagattc accaagcctt 19200
aacccgctct tcctcaatcc gtaacgtcct tcctcgtcac gaacaaggag gtgtattcgc 19260
agcagaagga tacgctcgat cctcaggtaa accaggtatc tgtatagcca cttcaggtcc 19320
cggagctaca aatctcgtta gcggattagc cgatgcgttg ttagatagtg ttcctcttgt 19380
agcaatcaca ggacaagtcc ctcgtcgtat gattggtaca gatgcgtttc aagagactcc 19440
gattgttgag gtaacgcgtt cgattacgaa gcataactat cttgtgatgg atgttgaaga 19500
tatccctagg attattgagg aagctttctt tttagctact tctggtagac ctggacctgt 19560
tttggttgat gttcctaaag atattcaaca acagcttgcg attcctaatt gggaacaggc 19620
tatgagatta cctggttata tgtctaggat gcctaaacct ccggaagatt ctcatttgga 19680
gcagattgtt aggttgattt ctgagtctaa gaagcctgtg ttgtatgttg gtggtggttg 19740
tttgaattct agcgatgaat tgggtaggtt tgttgagctt acggggatcc ctgttgcgag 19800
tacgttgatg ggctgggat cttatccttg tgatgatgag ttgtcgttac atatgcttgg 19860
aatgcatggg actgtgtatg caaattacgc tgtggagcat agtgatttgt tgttggcgtt 19920
tggggtaagg tttgatgatc gtgtcacggg taagcttgag gcttttgcta gtagggctaa 19980
gattgttcat attgatattg actcggctga gattgggaag aataagactc ctcatgtgtc 20040
tgtgtgtggt gatgttaagc tggctttgca agggatgaat aaggttcttg agaaccgagc 20100
ggaggagctt aagcttgatt ttggagtttg gaggaatgag ttgaacgtac agaaacagaa 20160
gtttccgttg agctttaaga cgtttgggga agctattcct ccacagtatg cgattaaggt 20220
ccttgatgag ttgactgatg gaaaagccat aataagtact ggtgtcgggc aacatcaaat 20280
gtgggcggcg cagttctaca attacaagaa accaaggcag tggctatcat caggaggcct 20340
tggagctatg ggatttggac ttcctgctgc gattggagcg tctgttgcta accctgatgc 20400
gatagttgtg gatattgacg gagatggaag ctttataatg aatgtgcaag agctagccac 20460
tattcgtgta gagaatcttc cagtgaaggt acttttatta aacaaccagc atcttggcat 20520
ggttatgcaa tgggaagatc ggttctacaa agctaaccga gctcacacat ttctcgggga 20580
tccggctcag gaggacgaga tattcccgaa catgttgctg tttgcagcag cttgcgggat 20640
tccagcggcg agggtgacaa agaaagcaga tctccgagaa gctattcaga caatgctgga 20700
tacaccagga ccttacctgt tggatgtgat ttgtccgcac caagaacatg tgttgccgat 20760
gatcccgaat ggtggcactt tcaacgatgt cataacggaa ggagatggcc ggattaaata 20820
ctgataggga taacagggta atctcgacga gatgaaaccg gtgattatca gaacctttta 20880
tggtctttgt atgcatatgg taaaaaaact tagtttgcaa tttcctgttt gttttggtaa 20940
tttgagtttc ttttagttgt tgatctgcct gctttttggt ttacgtcaga ctactactgc 21000
tgttgttgtt tggtttcctt tctttcattt tataaataaa taatccggtt cggtttactc 21060
cttgtgactg gctcagtttg gttattgcga aatgcgaatg gtaaattgag taattgaaat 21120
tcgttattag ggttctaagc tgttttaaca gtcactgggt taatatctct cgaatcttgc 21180
atggaaaatg ctcttaccat tggtttttaa ttgaaatgtg ctcatatggg ccgtggtttc 21240
caaattaaat aaaactacga tgtcatcgag aagtaaaatc aactgtgtcc acattatcag 21300
ttttgtgtat acgatgaaat agggtaattc aaaatctagc ttgatatgcc ttttggttca 21360
ttttaacctt ctgtaaacat tttttcagat tttgaacaag taaatccaaa aaaaaaaaaa 21420
aaaaatctca actcaacact aaattatttt aatgtataaa agatgcttaa aacatttggc 21480
ttaaaagaaa gaagctaaaa acatagagaa ctcttgtaaa ttgaagtatg aaaatatact 21540
gaattgggta ttatatgaat ttttctgatt taggattcac atgatccaaa aaggaaatcc 21600
agaagcacta atcagacatt ggaagtagga atatttcaaa aagttttttt tttttaagta 21660
agtgacaaaa gcttttaaaa aatagaaaag aaactagtat taaagttgta aatttaataa 21720
acaaaagaaa ttttttatat tttttcattt ctttttccag catgaggtta tgatggcagg 21780
atgtggattt catttttttc cttttgatag ccttttaatt gatctattat aattgacgaa 21840
aaaatattag ttaattatag atatatttta ggtagtatta gcaatttaca cttccaaaag 21900
actatgtaag ttgtaaatat gatgcgttga tctcttcatc attcaatggt tagtcaaaaa 21960
aataaaagct taactagtaa actaaagtag tcaaaaattg tactttagtt taaaatatta 22020
catgaataat ccaaaacgac atttatgtga aacaaaaaca atatgtcgag gcgatcgcag 22080
tacttaatca gtgatcagta actaaattca gtacattaaa gacgtccgca atgtgttatt 22140
aagttgtcta agcgtcaatt tgtttacacc acaatatatc ctgccaccag ccagccaaca 22200
gctccccgac cggcagctcg gcacaaaatc actgatcatc taaaaaggtg atgtgtattt 22260
gagtaaaaca gcttgcgtca tgcggtcgct gcgtatatga tgcgatgagt aaataaacaa 22320
atacgcaagg ggaacgcatg aaggttatcg ctgtacttaa ccagaaaggc gggtcaggca 22380
agacgaccat cgcaacccat ctagcccgcg ccctgcaact cgccggggcc gatgttctgt 22440
tagtcgattc cgatccccag ggcagtgccc gcgattgggc ggccgtgcgg gaagatcaac 22500
cgctaaccgt tgtcggcatc gaccgcccga cgattgaccg cgacgtgaag gccatcggcc 22560
ggcgcgactt cgtagtgatc gacggagcgc ccaggcggc ggacttggct gtgtccgcga 22620

tcaaggcagc cgacttcgtg ctgattccgg tgcagccaag cccttacgac atttgggcca 22680
ccgccgacct ggtggagctg gttaagcagc gcattgaggt cacggatgga aggctacaag 22740
cggcctttgt cgtgtcgcgg gcgatcaaag gcacgcgcat cggcggtgag gttgccgagg 22800
cgctggccgg gtacgagctg cccattcttg agtcccgtat cacgcagcgc gtgagctacc 22860
caggcactgc cgccgccggc acaaccgttc ttgaatcaga acccgagggc gacgctgccc 22920
gcgaggtcca ggcgctggcc gctgaaatta aatcaaaact catttgagtt aatgaggtaa 22980
agagaaaatg agcaaaagca caaacacgct aagtgccggc cgtccgagcg cacgcagcag 23040
caaggctgca acgttggcca gcctggcaga cacgccagcc atgaagcggg tcaactttca 23100
gttgccggcg gaggatcaca ccaagctgaa gatgtacgcg gtacgccaag gcaagaccat 23160
taccgagctg ctatctgaat acatcgcgca gctaccagag taaatgagca aatgaataaa 23220
tgagtagatg aattttagcg gctaaaggag gcggcatgga aaatcaagaa caaccaggca 23280
ccgacgccgt ggaatgcccc atgtgtggag gaacgggcgg ttggccaggc gtaagcggct 23340
gggttgtctg ccggccctgc aatggcactg gaacccccaa gcccgaggaa tcggcgtgag 23400
cggtcgcaaa ccatccggcc cggtacaaat cggcgcggcg ctgggtgatg acctggtgga 23460
gaagttgaag gccgcgcagg ccgcccagcg gcaacgcatc gaggcagaag cacgccccgg 23520
tgaatcgtgg caagcggccg ctgatcgaat ccgcaaagaa tcccggcaac cgccggcagc 23580
cggtgcgccg tcgattagga agccgcccaa gggcgacgag caaccagatt ttttcgttcc 23640
gatgctctat gacgtgggca cccgcgatag tcgcagcatc atggacgtgg ccgttttccg 23700
tctgtcgaag cgtgaccgac gagctggcga ggtgatccgc tacgagcttc cagacgggca 23760
cgtagaggtt tccgcaggcc ccgccggcat ggccagtgtg tgggattacg acctggtact 23820
gatggcggtt tcccatctaa ccgaatccat gaaccgatac cgggaaggga agggagacaa 23880
gcccggccgc gtgttccgtc cacacgttgc ggacgtactc aagttctgcc ggcgagccga 23940
tggcggaaag cagaaagacg acctggtaga aacctgcatt cggttaaaca ccacgcacgt 24000
tgccatgcag cgtaccaaga aggccaagaa cggccgcctg gtgacggtat ccgagggtga 24060
agccttgatt agccgctaca agatcgtaaa gagcgaaacc gggcggccgg agtacatcga 24120
gatcgagctt gctgattgga tgtaccgcga gatcacagaa ggcaagaacc cggacgtgct 24180
gacggttcac cccgattact ttttgatcga ccccggcatc ggccgttttc tctaccgcct 24240
ggcacgccgc gccgcaggca aggcagaagc cagatggttg ttcaagacga tctacgaacg 24300
cagtggcagc gccggagagt tcaagaagtt ctgtttcacc gtgcgcaagc tgatcgggtc 24360
aaatgacctg ccggagtacg atttgaagga ggaggcgggg caggctggcc cgatcctagt 24420
catgcgctac cgcaacctga tcgagggcga agcatccgcc ggttcctaat gtacggagca 24480
gatgctaggg caaattgccc tagcagggga aaaaggtcga aaaggtctct ttcctgtgga 24540
tagcacgtac attgggaacc caaagccgta cattgggaac cggaacccgt acattgggaa 24600
cccaaagccg tacattggga accggtcaca catgtaagtg actgatataa aagagaaaaa 24660
aggcgatttt tccgcctaaa actctttaaa acttattaaa actcttaaaa cccgcctggc 24720
ctgtgcataa ctgtctggcc agcgcacagc cgaagagctg caaaaagcgc ctacccttcg 24780
gtcgctgcgc tccctacgcc ccgccgcttc gcgtcggcct atcgcggcct atgcggtgtg 24840
aaataccgca cagatgcgta aggagaaaat accgcatcag gcgctcttcc gcttcctcgc 24900
tcactgactc gctgcgctcg gtcgttcggc tgcggcgagc ggtatcagct cactcaaagg 24960
cggtaatacg gttatccaca gaatcagggg ataacgcagg aaagaacatg tgagcaaaag 25020
gccagcaaaa ggccaggaac cgtaaaaagg ccgcgttgct ggcgtttttc cataggctcc 25080
gcccccctga cgagcatcac aaaaatcgac gctcaagtca gaggtggcga aacccgacag 25140
gactataaag ataccaggcg tttccccctg gaagctccct cgtgcgctct cctgttccga 25200
ccctgccgct taccggatac ctgtccgcct ttctcccttc gggaagcgtg gcgctttctc 25260
atagctcacg ctgtaggtat ctcagttcgg tgtaggtcgt tcgctccaag ctgggctgtg 25320
tgcacgaacc ccccgttcag cccgaccgct gcgccttatc cggtaactat cgtcttgagt 25380
ccaacccggt aagacacgac ttatcgccac tggcagcagc cactggtaac aggattagca 25440
gagcgaggta tgtaggcggt gctacagagt tcttgaagtg gtggcctaac tacggctaca 25500
ctagaaggac agtatttggt atctgcgctc tgctgaagcc agttaccttc ggaaaaagag 25560
ttggtagctc ttgatccggc aaacaaacca ccgctggtag cggtggtttt tttgtttgca 25620
agcagcagat tacgcgcaga aaaaaaggat ctcaagaaga tcctttgatc ttttctacgg 25680
ggtccttcaa ctcatcgata gtttggctgt gagcaattat gtgcttagtg catctaacgc 25740
ttgagttaag ccgcgccgcg aagcggcgtc ggcttgaacg aatttctagc tagacattat 25800
ttgccaacga ccttcgtgat ctcgcccttg acatagtgga caaattcttc gagctggtcg 25860
gcccgggacg cgagacggtc ttcttcttgg cccagatagg cttggcgcgc ttcgaggatc 25920
acgggctggt attgcgccgg aaggcgctcc atcgcccagt cggcggcgac atccttcggc 25980
gcgatcttgc cggtaaccgc cgagtaccaa atccggctca gcgtaaggac cacattgcgc 26040
tcatcgcccg cccaatccgg cggggagttc cacagggtca gcgtctcgtt cagtgcttcg 26100
aacagatcct gttccggcac cgggtcgaaa agttcctcgg ccgcggggcc gacgagggcc 26160
acgctatgct cccgggcctt ggtgagcagg atcgccagat caatgtcgat ggtggccggt 26220
tcaaagatac ccgccagaat atcattacgc tgccattcgc cgaactggag ttcgcgtttg 26280
gccggatagc gccaggggat gatgtcatcg tgcaccacaa tcgtcacctc aaccgcgcgc 26340
aggatttcgc tctcgccggg ggaggcggac gtttccagaa ggtcgttgat aagcgcgcgg 26400
cgcgtggtct cgtcgagacg gacggtaacg gtgacaagca ggtcgatgtc cgaatggggc 26460
ttaaggccgc cgtcaacggc gctaccatac agatgcacgg cgaggagggt cggttcgagg 26520
tggcgctcga tgacacccac gacttccgac agctgggtgg acacctcggc gatgaccgct 26580
tcacccatga tgtttaactt tgttttaggg cgactgccct gctgcgtaac atcgttgctg 26640
ctccataaca tcaaacatcg acccacggcg taacgcgctt gctgcttgga tgcccgaggc 26700

atagactgta ccccaaaaaa acagtcataa caagccatga aaaccgccac tgcgttccat 26760
gaatattcaa acaaacacat acagcgcgac ttatcatgga ta 26802

<210> 6
<211> 30687
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 6
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc 240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa 300
gcttggccac taaggccaat ttaaatctac taggccggcc acacgggcag gacataggga 360
ctactacaag catagtatgc ttcagacaaa gagctaggaa agaactcttg atggaggtta 420
agagaaaaaa gtgctagagg ggcatagtaa tcaaacttgt caaaaccgtc atcatgatga 480
gggatgacat aatataaaaa gttgactaag gtcttggtag tactctttga ttagtattat 540
atattggtga gaacatgagt caagaggaga caagaaaccg aggaaccata gtttagcaac 600
aagatggaag ttgcaaagtt gagctagccg ctcgattagt tacatctcct aagcagtact 660
acaaggaatg gtctctatac tttcatgttt agcacatggt agtgcggatt gacaagttag 720
aaacagtgct taggagacaa agagtcagta aaggtattga aagagtgaag ttgatgctcg 780
acaggtcagg agaagtccct ccgccagatg gtgactacca aggggttggt atcagctgag 840
acccaaataa gattcttcgg ttgaaccagt ggttcgaccg agactcttag ggtgggattt 900
cactgtaaga tttgtgcatt ttgttgaata taaattgaca attttttttta tttaattata 960
gattatttag aatgaattac atatttagtt tctaacaagg atagcaatgg atgggtatgg 1020
gtacaggtta aacatatcta ttacccaccc atctagtcgt cgggttttac acgtacccac 1080
ccgtttacat aaaccagacc ggaattttaa accgtacccg tccgttagcg ggtttcagat 1140
ttacccgttt aatcgggtaa aacctgatta ctaaatatat attttttatt tgataaacaa 1200
aacaaaaatg ttaatatttt catattggat gcaattttaa gaaacacata ttcataaatt 1260
tccatatttg taggaaaata aaaagaaaaa tatattcaag aacacaaatt tcaccgacat 1320
gacttttatt acagagttgg aattagatct aacaattgaa aaattaaaat taagatagaa 1380
tatgttgagg aacatgacat agtataatgc tgggttaccc gtcgggtagg tatcgaggcg 1440
gatactacta aatccatccc actcgctatc cgataatcac tggtttcggg tatacccatt 1500
cccgtcaaca ggccttttta accggataat ttcaacttat agtgaatgaa ttttgaataa 1560
atagttagaa taccaaaatc ctggattgca tttgcaatca aattttgtga accgttaaat 1620
tttgcatgta cttgggatag atataataga accgaatttt cattagttta atttataact 1680
tactttgttc aaagaaaaaa aatatctatc caatttactt ataataaaaa ataatctatc 1740
caagttactt attataatca acttgtaaaa aggtaagaat acaaatgtgg tagcgtacgt 1800
gtgattatat gtgacgaaat gttatatcta acaaaagtcc aaattcccat ggtaaaaaaa 1860
atcaaaatgc atggcaggct gtttgtaacc ttggaataag atgttggcca attctggagc 1920
cgccacgtac gcaagactca gggccacgtt ctcttcatgc aaggatagta gaacaccact 1980
ccacccacct cctatattag acctttgccc aaccctcccc aactttccca tcccatccac 2040
aaagaaaccg acatttttat cataaatcag ggtttcgttt ttgtttcatc gataaactca 2100
aaggtgatga ttttagggtc ttgtgagtgt gctttttttgt ttgattctac tgtagggttt 2160
atgttcttta gctcataggt tttgtgtatt tcttagaaat gtggcttctt taatctctgg 2220
gtttgtgact ttttgtgtgg tttctgtgtt tttcatatca aaaacctatt ttttccgagt 2280
ttttttttac aaattcttac tctcaagctt gaatacttca catgcagtgt tcttttgtag 2340
attttagagt taatgtgtta aaaagtttgg atttttcttg cttatagagc ttcttcactt 2400
tgattttgtg ggtttttttg ttttaaaggt gagatttttg atgaggtttt tgcttcaaag 2460
atgtcacctt tctgggtttg tcttttgaat aaagctatga actgtcacat ggctgacgca 2520
attttgttac tatgtcatga aagctgacgt ttttccgtgt tatacatgtt tgcttacact 2580
tgcatgcgtc aaaaaaattg gggcttttta gttttagtca aagattttac ttctcttttg 2640
ggatttatga aggaaagttg caaactttct caaattttac catttttgct ttgatgtttg 2700
tttagattgc gacagaacaa actcatatat gttgaaattt ttgcttggtt ttgtatagga 2760
ttgtgtcttt tgcttataaa tgttgaaatc tgaacttttt ttttgtttgg tttctttgag 2820
caggagataa ggcgcgccac catggcttct acatctgctg ctcaagacgc tgctccttac 2880
gagttccctt ctctcactga gatcaagagg gctcttcctt ctgagtgttt cgaggcttct 2940
gttcctcttt ctctctacta caccgctaga tctcttgctc ttgctggatc tctcgctgtt 3000
gctctctctt acgctagagc tttgcctctt gttcaggcta acgctcttct tgatgctact 3060
ctctgcactg gatacgttct tctccaggga atcgttttct ggggattctt caccgttggt 3120
cacgattgtg gacacggagc tttctctaga tctcacgtgc tcaacttctc tgttggaacc 3180
ctcatgcact ctatcatcct taccccctttc gagtcttgga agctctctca cagacaccac 3240
cacaagaaca ccggaaacat cgataaggac gagatcttct accctcaaag agaggctgat 3300
tctcaccctg tttctagaca ccttgtgatg tctcttggat ctgcttggtt cgcttacctt 3360

```
ttcgctggat tccctcctag aaccatgaac cacttcaacc cttgggaggc tatgtatgtt   3420
agaagagtgg ctgctgtgat catctctctc ggagttcttt tcgctttcgc tggactctac   3480
tcttacctca ccttcgttct tggattcacc actatggcta tctactactt cggacctctc   3540
ttcatcttcg ctaccatgct tgttgttacc actttcctcc accacaacga tgaggagaca   3600
ccttggtacg ctgattctga gtggacttac gtgaagggaa acctctcttc tgtggacaga   3660
tcttacggtg ctctcatcga caaccttagc cacaacatcg gaactcacca gatccaccac   3720
ctcttcccta tcatccctca ctacaagctc aacgatgcta ctgctgcttt cgctaaggct   3780
ttccctgagc ttgttaggaa aaacgctgct cctatcatcc caactttctt caggatggct   3840
gctatgtacg ctaagtacgg agttgttgac actgatgcta agaccttcac tctcaaggag   3900
gctaaggctg ctgctaagac taagtcatct tgatgattaa ttaaggccgc agatatcaga   3960
tctggtcgac ctagaggatc cccggccgca aagataataa caaaagccta ctatataacg   4020
tacatgcaag tattgtatga tattaatgtt tttacgtacg tgtaaacaaa aataattacg   4080
tttgtaacgt atggtgatga tgtggtgcac taggtgtagg ccttgtatta ataaaaagaa   4140
gtttgttcta tatagagtgg tttagtacga cgatttattt actagtcgga ttggaataga   4200
gaaccgaatt cttcaatcct tgcttttgat caagaattga aaccgaatca aatgtaaaag   4260
ttgatatatt tgaaaaacgt attgagctta tgaaaatgct aatactctca tctgtatgga   4320
aaagtgactt taaaaccgaa cttaaaagtg acaaaagggg aatatcgcat caaaccgaat   4380
gaaaccgatg gcgcctacta ccggtaattc ccgggattag cggccgctag tctgtgcgca   4440
cttgtatcct gcaggttagg ccggccatta gcagatattt ggtgtctaaa tgtttatttt   4500
gtgatatgtt catgtttgaa atggtggttt cgaaaccagg gacaacgttg ggatctgata   4560
gggtgtcaaa gagtattatg gattgggaca atttcggtca tgagttgcaa attcaagtat   4620
atcgttcgat tatgaaaatt ttcgaagaat atcccatttg agagagtctt tacctcatta   4680
atgtttttag attatgaaat tttatcatag ttcatcgtag tctttttggt gtaaaggctg   4740
taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag gctgtaaaag attgtaaaag   4800
actattttgg tgttttggat aaaatgatag tttttataga ttcttttgct tttagaagaa   4860
atacatttga aatttttttcc atgttgagta taaaataccg aaatcgattg aagatcatag   4920
aaatatttta actgaaaaca aatttataac tgattcaatt ctctccattt ttatacctat   4980
ttaaccgtaa tcgattctaa tagatgatcg attttttata taatcctaat taaccaacgg   5040
catgtattgg ataattaacc gatcaactct cacccctaat agaatcagta ttttccttcg   5100
acgttaattg atcctacact atgtaggtca tatccatcgt tttaattttt ggccaccatt   5160
caattctgtc ttgcctttag ggatgtgaat atgaacggcc aaggtaagag aataaaaata   5220
atccaaatta aagcaagaga ggccaagtaa gataatccaa atgtacactt gtcattgcca   5280
aaattagtaa aatactcggc atattgtatt cccacacatt attaaaatac cgtatatgta   5340
ttggctgcat ttgcatgaat aatactacgt gtaagcccaa aagaacccac gtgtagccca   5400
tgcaaagtta acactcacga ccccattcct cagtctccac tatataaacc caccatcccc   5460
aatctcacca aacccaccac acaactcaca actcactctc acaccttaaa gaaccaatca   5520
ccaccaaaaa atttcacgat ttggaatttg attcctgcga tcacaggtat gacaggttag   5580
attttgtttt gtatagttgt atacatactt ctttgtgatg ttttgtttac ttaatcgaat   5640
ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga aaatatcact gtgtgtgtgt   5700
tcttatgatt cacagtgttt atgggtttca tgttctttgt tttatcattg aatgggaaga   5760
aatttcgttg ggatacaaat ttctcatgtt cttactgatc gttattagga gtttggggaa   5820
aaaggaagag ttttttttggt tggttcgagt gattatgagg ttatttctgt atttgattta   5880
tgagttaatg gtcgttttaa tgttgtagac catgggaaaa ggatctgagg gaagatctgc   5940
tgctagagag atgactgctg aggctaacgg agataagaga aagaccatcc tcattgaggg   6000
agtgttgtac gatgctacca acttcaaaca cccaggaggt tccattatta acttcctcac   6060
cgagggagaa gctggagttg atgctaccca agcttacaga gagttccatc agagatccgg   6120
aaaggctgat aagtacctca agtccctccc aaagttggat gcttctaagg tggagtctag   6180
gttctctgct aaggagcagg ctagaaggga cgctatgacc agggattacg ctgctttcag   6240
agaggagttg gttgctgagg gatacttcga tccatctatc ccacacatga tctacagagt   6300
ggtggagatt gtggctttgt tcgctttgtc tttctggttg atgtctaagg cttctccaac   6360
ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa ggaagatgcg gatgggttat   6420
gcacgagatg ggacacggat ctttcactgg agttatctgg ctcgatgata ggatgtgcga   6480
gttcttctac ggagttggat gtggaatgtc tggacactac tggaagaacc agcactctaa   6540
gcaccacgct gctccaaaca gattggagca cgatgtggat ttgaacacct tgccactcgt   6600
tgctttcaac gagagagttg tgaggaaggt taagccagga tctttgttgg ctttgtggct   6660
cagagttcag gcttatttgt tcgctccagt gtcttgcttg ttgatcggat tgggatggac   6720
cttgtacttg cacccaagat atatgctcag gaccaagaga cacatggagt ttgtgtggat   6780
cttcgctaga tatatcggat ggttctcctt gatgggagct ttgggatatt ctcctggaac   6840
ttctgtggga atgtacctct gctctttcgg acttggatgc atctacatct tcctccaatt   6900
cgctgtgtct cacacccact tgccagttac caacccagag gatcaattgc actggcttga   6960
gtacgctgct gatcacaccg tgaacatctc taccaagtct tggttggtta cctggtggat   7020
gtctaacctc aacttccaaa tcgagcacca cttgttccca accgctccac aattcaggtt   7080
caaggagatc tctccaagag ttgaggctct cttcaagaga cacaacctcc cttactacga   7140
tttgccatac acctctgctg tttctactac cttcgctaac ctctactctg ttggacactc   7200
tgttggagct gataccaaga agcaggattg actgctttaa tgagatatgc gagacgccta   7260
tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt gtaaaaaacc tgagcatgtg   7320
tagctcagat ccttaccgcc ggtttcggtt cattctaatg aatatatcac ccgttactat   7380
cgtattttta tgaataatat tctccgttca atttactgat tgtgtcgacg cgatcgcgtg   7440
```

```
caaacactgt acggaccgtg gcctaatagg ccggtaccca agtttgtaca aaaaagcagg   7500
ctccatgatt acgccaagct tggccactaa ggccaattta aatctactag gccggccatc   7560
gacggcccgg actgtatcca acttctgatc tttgaatctc tctgttccaa catgttctga   7620
aggagttcta agacttttca gaaagcttgt aacatgcttt gtagactttc tttgaattac   7680
tcttgcaaac tctgattgaa cctacgtgaa aactgctcca gaagttctaa ccaaattccg   7740
tcttgggaag gcccaaaatt tattgagtac ttcagtttca tggacgtgtc ttcaaagatt   7800
tataacttga aatcccatca tttttaagag aagttctgtt ccgcaatgtc ttagatctca   7860
ttgaaatcta caactcttgt gtcagaagtt cttccagaat caacttgcat catggtgaaa   7920
atctggccag aagttctgaa cttgtcatat ttcttaacag ttagaaaaat ttctaagtgt   7980
ttagaatttt gacttttcca aagcaaactt gacttttgac tttcttaata aaacaaactt   8040
catattctaa catgtcttga tgaaatgtga ttcttgaaat ttgatgttga tgcaaaagtc   8100
aaagtttgac ttttcagtgt gcaattgacc attttgctct tgtgccaatt ccaaacctaa   8160
attgatgtat cagtgctgca aacttgatgt catggaagat cttatgagaa aattcttgaa   8220
gactgagagg aaaaatttg tagtacaaca caaagaatcc tgtttttcat agtcggacta   8280
gacacattaa cataaaacac cacttcattc gaagagtgat tgaagaagga aatgtgcagt   8340
tacctttctg cagttcataa gagcaactta cagacacttt tactaaaata ctacaaagag   8400
gaagatttta acaacttaga gaagtaatgg gagttaaaga gcaacacatt aagggggagt   8460
gttaaaatta atgtgttgta accaccacta cctttagtaa gtattataag aaaattgtaa   8520
tcatcacatt ataattattg tccttattta aaattatgat aaagttgtat cattaagatt   8580
gagaaaacca aatagtcctc gtcttgattt ttgaattatt gtttctatg ttacttttct   8640
tcaagcctat ataaaaactt tgtaatgcta aattgtatgc tggaaaaaaa tgtgtaatga   8700
attgaataga aattatggta tttcaaagtc caaaatccat caatagaaat ttagtacaaa   8760
acgtaactca aaaatattct cttattttaa attttacaac aatataaaaa tattctctta   8820
ttttaaattt tacaataata taatttatca cctgtcacct ttagaatacc accaacaata   8880
ttaatactta gatattttat tcttaataat tttgagatct ctcaatatat ctgatattta   8940
ttttatattt gtgtcatatt ttcttatgtt ttagagttaa cccttatatc ttggtcaaac   9000
tagtaattca atatatgagt ttgtgaagga cacattgaca tcttgaaaca ttggttttaa   9060
ccttgttgga atgttaaagg taataaaaca ttcagaatta tgaccatcta ttaatatact   9120
tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat ggtaagctag agtgtcttgc   9180
tggcctgtgt atatcaattc catttccaga tggtagaaac tgccactacg aataattagt   9240
cataagacac gtatgttaac acacgtcccc ttgcatgttt tttgccatat attccgtctc   9300
tttcttttc ttcacgtata aaacaatgaa ctaattaata gagcgatcaa gctgaacagt   9360
tctttgcttt cgaagttgcc gcaacctaaa caggtttttc cttcttcttt cttcttatta   9420
actacgacct tgtcctttgc ctatgtaaaa ttactaggtt ttcatcagtt acactgatta   9480
agttcgttat agtggaagat aaaatgccct caaagcattt tgcaggatat ctttgatttt   9540
tcaaagatat ggaactgtag agtttgatag tgttcttgaa tgtggttgca tgaagttttt   9600
ttggtctgca tgttattttt tcctcgaaat atgttttgag tccaacaagt gattcacttg   9660
ggattcagaa agttgttttc tcaatatgta acagtttttt tctatggaga aaaatcatag   9720
ggaccgttgg ttttggcttc tttaattttg agctcagatt aaacccattt tacccggtgt   9780
tcttggcaga attgaaaaca gtacgtagta ccgcgcctac catgtgtgtt gagaccgaga   9840
acaacgatgg aatccctact gtggagatcg ctttcgatgg agagagagaa agagctgagg   9900
ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc tttggctaag accttcgcta   9960
gaagatacgt ggttatcgag ggagttgagt acgatgtgac cgatttcaaa catcctggag  10020
gaaccgtgat tttctacgct ctctctaaca ctggagctga tgctactgag gctttcaagg  10080
agttccacca cagatctaga aaggctagga aggctttggc tgctttgcct tctagacctg  10140
ctaagaccgc taaagtggat gatgctgaga tgctccagga tttcgctaag tggagaaagg  10200
agttggagag ggacggattc ttcaagcctt ctcctgctca tgttgcttac agattcgctg  10260
agttggctgc tatgtacgct ttgggaacct acttgatgta cgctagatac gttgtgtcct  10320
ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg atgggttcaa cacgagggag  10380
gacactcttc tttgaccgga aacatctggt gggataagag aatccaagct ttcactgctg  10440
gattcggatt ggctggatct ggagatatgt ggaactccat gcacaacaag caccacgcta  10500
ctcctcaaaa agtgaggcac gatatggatt tggataccac tcctgctgtt gctttcttca  10560
acaccgctgt ggaggataat agacctaggg gattctctaa gtactggctc agattgcaag  10620
cttggacctt cattcctgtg acttctggat tggtgttgct cttctggatg ttcttcctcc  10680
acccttctaa ggctttgaag ggaggaaagt acgaggagct tgtgtggatg ttggctgctc  10740
acgtgattag aacctggacc attaaggctg ttactggatt caccgctatg caatcctacg  10800
gactcttctt ggctacttct tgggtttccg gatgctactt gttcgctcac ttctctactt  10860
ctcacaccca cttggatgtt gttcctgctg atgagcactt gtcttgggtt aggtacgctg  10920
tggatcacac cattgatatc gatccttctc agggatgggt taactggttg atgggatact  10980
tgaactgcca agtgattcac cacctcttcc cttctatgcc tcaattcaga caacctgagg  11040
tgtccagaag attcgttgct ttcgctaaga agtggaacct caactacaag gtgatgactt  11100
atgctggagc ttggaaggct actttgggaa acctcgataa tgtgggaaag cactactacg  11160
tgcacggaca acactctgga aagaccgctt gattaattaa ggccgcctcg accgtacccc  11220
ctgcagatag actatactat gttttagcct gcctgctggc tagctactat gttatgttat  11280
gttgtaaaat aaacacctgc taaggtatat ctatctatat tttagcatgg ctttctcaat  11340
aaattgtctt tccttatcgt ttactatctt atacctaata atgaaataat aatatcacat  11400
atgaggaacg gggcaggttt aggcatatat atacgagtgt agggcggagt ggggggcgcc  11460
tactaccggt aattcccggg attagcggcc gctagtctgt gcgcacttgt atcctgcagg  11520
```

ttaggccggc caaagcttta caacgctaca caaaacttat aaccgtaatc accattcatt 11580
aacttaacta ctatcacatg cattcatgaa ttgaaacgag aaggatgtaa atagttggga 11640
agttatctcc acgttgaaga gatcgttagc gagagctgaa agaccgaggg aggagacgcc 11700
gtcaacacgg acagagtcgt cgaccctcac atgaagtagg aggaatctcc gtgaggagcc 11760
agagagacgt ctttggtctt cggtttcgat ccttgatctg acggagaaga cgagagaagt 11820
gcgactggac tccgtgagga ccaacagagt cgtcctcggt ttcgatcgtc ggtattggtg 11880
gagaaggcgg aggaatctcc gtgacgagcc agagagatgt cgtcggtctt cggtttcgat 11940
ccttgatctg acggagaaga cgagagaagt gcgacgagac tccgtgagga ccaacagagt 12000
tgtcctcggt ttcgatcgtc ggtttcggcg gagaaggcgg aggaatctcc gtgaggagcc 12060
agagagacgt cgttggtctt cggtttcgat ccttgatctg ttggagaaga cgagacaagt 12120
gggacgagac tcaacgacgg agtcagagac gtcgtcggtc ttcggtttcg gccgagaagg 12180
cggagtcggt cttcggtttc ggccgagaag gcggaggaga cgtcttcgat ttgggtctct 12240
cctcttgacg aagaaaacaa agaacacgag aaataatgag aaagagaaca aaagaaaaaa 12300
aaataaaaat aaaaataaaa tttggtcctc ttatgtggtg acacgtggtt tgaaacccac 12360
caaataatcg atcacaaaaa acctaagtta aggatcggta ataacctttc taattaattt 12420
tgatttatat taaatcactc tttttattta taaaccccac taaattatgc gatattgatt 12480
gtctaagtac aaaaattctc tcgaattcaa tacacatgtt tcatatattt agccctgttc 12540
atttaatatt actagcgcat ttttaattta aaattttgta aactttttttg gtcaaagaac 12600
atttttttaa ttagagacag aaatctagac tctttatttg gaataatagt aataaagata 12660
tattaggcaa tgagtttatg atgttatgtt tatatagttt atttcatttt aaattgaaaa 12720
gcattatttt tatcgaaatg aatctagtat acaatcaata tttatgtttt ttcatcagat 12780
actttcctat tttttggcac ctttcatcgg actactgatt tatttcaatg tgtatgcatg 12840
catgagcatg agtatacaca tgtcttttaa aatgcatgta aagcgtaacg gaccacaaaa 12900
gaggatccat acaaatacat ctcatcgctt cctctactat tctccgacac acacactgag 12960
catggtgctt aaacactctg gtgagttcta gtacttctgc tatgatcgat ctcattacca 13020
tttcttaaat ttctctccct aaatattccg agttcttgat ttttgataac ttcaggtttt 13080
ctctttttga taaatctggt ctttccattt tttttttttt gtggttaatt tagtttccta 13140
tgttcttcga ttgtattatg catgatctgt gtttggattc tgttagatta tgtattggtg 13200
aatatgtatg tgtttttgca tgtctggttt tggtcttaaa aatgttcaaa tctgatgatt 13260
tgattgaagc ttttttagtg ttggtttgat tcttctcaaa actactgtta atttactatc 13320
atgttttcca actttgattc atgatgacac ttttgttctg ctttgttata aaattttggt 13380
tggtttgatt ttgtaattat agtgtaattt tgttaggaat gaacatgttt taatactctg 13440
ttttcgattt gtcacacatt cgaattatta atcgataatt taactgaaaa ttcatggttc 13500
tagatcttgt tgtcatcaga ttatttgttt cgataattca tcaaatatgt agtccttttg 13560
ctgatttgcg actgtttcat tttttctcaa aattgttttt tgttaagttt atctaacagt 13620
tatcgttgtc aaaagtctct ttcattttgc aaaatcttct tttttttttt gtttgtaact 13680
ttgtttttta agctacacat ttagtctgta aaatagcatc gaggaacagt tgtcttagta 13740
gacttgcatg ttcttgtaac ttctatttgt ttcagtttgt tgatgactgc tttgattttg 13800
taggtcaaac catggatgct tataacgctg ctatggataa gattggagct gctatcatcg 13860
attggagtga tccagatgga aagttcagag ctgataggga ggattggtgg ttgtgcgatt 13920
tcagatccgc tatcaccatt gctctcatct acatcgcttt cgtgatcttg ggatctgctg 13980
tgatgcaatc tctcccagct atggacccat accctatcaa gttcctctac aacgtgtctc 14040
aaatcttcct ctgcgcttac atgactgttg aggctggatt cctcgcttat aggaacggat 14100
acaccgttat gccatgcaac cacttcaacg tgaacgatcc accagttgct aacttgctct 14160
ggctcttcta catctccaaa gtgtgggatt tctgggatac catcttcatt gtgctcggaa 14220
agaagtggag acaactctct ttcttgcacg tgtaccacca caccaccatc ttcctcttct 14280
actggttgaa cgctaacgtg ctctacgatg gagatatctt cttgaccatc ctcctcaacg 14340
gattcattca caccgtgatg tacacctact acttcatctg catgcacacc aaggattcta 14400
agaccggaaa gtctttgcca atctggtgga agtcatcttt gaccgctttc caactcttgc 14460
aattcaccat catgatgtcc caagctacct acttggtttt ccacggatgc gataaggttt 14520
ccctcagaat caccatcgtg tacttcgtgt acattctctc ccttttcttc ctcttcgctc 14580
agttcttcgt gcaatcctac atggctccaa agaagaagaa gtccgcttga tgttaattaa 14640
ctaagtttga tgtatctgag tgccaacgtt tactttgtct ttcctttctt ttattggtta 14700
tgattagatg tttactatgt tctctctttt tcgttataaa taaagaagtt caattcttct 14760
atagtttcaa acgcgatttt aagcgtttct atttaggttt acatgatttc ttttacaaaa 14820
tcatctttaa aatacagtat atttttagtt ttcataaaat atttaaagaa atgaaagttt 14880
ataaacattc actcctattc tctaattaag gatttgtaaa acaaaaattt tgtaagcata 14940
tcgatttatg cgttttgtct taattagctc actaaataat aaataatagc ttatgttgtg 15000
ggactgttta attacctaac ttagaactaa aatcaactct ttgtgggcaa acactgtacg 15060
gaccgtggcc taataggccg gtaccaccca gctttcttgt acaaagtggc catgattacg 15120
ccaagcttgg ccactaaggc caatttaaat ctactaggcc ggccataagg atgacctacc 15180
cattcttgag acaaatgtta cattttagta tcagagtaaa atgtgtacct ataactcaaa 15240
ttcgattgac atgtatccat tcaacataaa attaaaccag cctgcacctg catccacatt 15300
tcaagtattt tcaaaccgtt cggctcctat ccaccgggtg taacaagacg gattccgaat 15360
ttggaagatt ttgactcaaa ttcccaattt atattgaccg tgactaaatc aactttaact 15420
tctataattc tgattaagct cccaatttat attcccaacg gcactacctc caaaatttat 15480
agactctcat cccctttaa accaacttag taaacgtttt ttttttaatt ttatgaagtt 15540
aagtttttac cttgttttta aaaagaatcg ttcataagat gccatgccag aacattagct 15600

```
acacgttaca catagcatgc agccgcggag aattgttttt cttcgccact tgtcactccc  15660
ttcaaacacc taagagcttc tctctcacag cacacacata caatcacatg cgtgcatgca  15720
ttattacacg tgatcgccat gcaaatctcc tttatagcct ataaattaac tcatcggctt  15780
cactctttac tcaaaccaaa actcatcaat acaaacaaga ttaaaaacat ttcacgattt  15840
ggaatttgat tcctgcgatc acaggtatga caggttagat tttgttttgt atagttgtat  15900
acatacttct ttgtgatgtt ttgtttactt aatcgaattt ttggagtgtt ttaaggtctc  15960
tcgtttagaa atcgtggaaa atatcactgt gtgtgtgttc ttatgattca cagtgtttat  16020
gggtttcatg ttctttgttt tatcattgaa tgggaagaaa tttcgttggg atacaaattt  16080
ctcatgttct tactgatcgt tattaggagt ttggggaaaa aggaagagtt tttttggttg  16140
gttcgagtga ttatgaggtt atttctgtat ttgatttatg agttaatggt cgttttaatg  16200
ttgtagaccg ccatggctat tttgaaccct gaggctgatt ctgctgctaa cctcgctact  16260
gattctgagg ctaagcaaag acaattggct gaggctggat acactcatgt tgagggtgct  16320
cctgctcctt tgcctttgga gttgcctcat ttctctctca gagatctcag agctgctatt  16380
cctaagcact gcttcgagag atctttcgtg acctccacct actacatgat caagaacgtg  16440
ttgacttgcg ctgctttgtt ctacgctgct accttcattg atagagctgg agctgctgct  16500
tatgttttgt ggcctgtgta ctggttcttc cagggatctt acttgactgg agtgtgggtt  16560
atcgctcatg agtgtggaca tcaggcttat tgctcttctg aggtggtgaa caacttgatt  16620
ggactcgtgt tgcattctgc tttgttggtg ccttaccact cttggagaat ctctcacaga  16680
aagcaccatt ccaacactgg atcttgcgag aacgatgagg ttttcgttcc tgtgaccaga  16740
tctgtgttgg cttcttcttg gaacgagacc ttggaggatt ctcctctcta ccaactctac  16800
cgtatcgtgt acatgttggt tgttggatgg atgcctggat acctcttctt caacgctact  16860
ggacctacta agtactgggg aaagtctagg tctcacttca acccttactc cgctatctat  16920
gctgataggg agagatggat gatcgtgctc tccgatattt tcttggtggc tatgttggct  16980
gttttggctg ctttggtgca cactttctcc ttcaacacca tggtgaagtt ctacgtggtg  17040
ccttacttca ttgtgaacgc ttacttggtg ttgattacct acctccaaca caccgatacc  17100
tacatccctc atttcagaga gggagagtgg aattggttga gaggagcttt gtgcactgtg  17160
gatagatcat ttggtccatt cctcgattct gtggtgcata gaatcgtgga tacccatgtt  17220
tgccaccaca tcttctccaa gatgcctttc tatcattgcg aggaggctac caacgctatt  17280
aagcctctcc tcggaaagtt ctacttgaag gataccactc ctgttcctgt tgctctctgg  17340
agatcttaca cccattgcaa gttcgttgag gatgatggaa aggtggtgtt ctacaagaac  17400
aagctctagt taattaataa ttgattggtt cgagtattat ggcattggga aaactgtttt  17460
tcttgtacca tttgttgtgc ttgtaattta ctgtgttttt tattcggttt tcgctatcga  17520
actgtgaaat ggaaatggat ggagaagagt taatgaatga tatggtcctt ttgttcattc  17580
tcaaattaat attatttgtt ttttctctta tttgttgtgt gttgaatttg aaattataag  17640
agatatgcaa acattttgtt ttgagtaaaa atgtgtcaaa tcgtggcctc taatgaccga  17700
agttaatatg aggagtaaaa cacttgtagt tgtaccatta tgcttattca ctaggcaaca  17760
aatatatttt cagacctaga aaagctgcaa atgttactga atacaagtat gtcctcttgt  17820
gttttagaca tttatgaact ttcctttatg taattttcca gaatccttgt cagattctaa  17880
tcattgcttt ataattatag ttatactcat ggatttgtag ttgagtatga aaatattttt  17940
taatgcattt tatgacttgc caattgattg acaacatgca tcaatggcgc ctactaccgg  18000
taattcccgg gattagcggc cgctagtctg tgcgcacttg tatcctgcag gttaggccgg  18060
ccactgcagc aaatttacac attgccacta aacgtctaaa cccttgtaat ttgtttttgt  18120
tttactatgt gtgttatgta tttgatttgc gataaatttt tatatttggt actaaattta  18180
taacaccttt tatgctaacg tttgccaaca cttagcaatt tgcaagttga ttaattgatt  18240
ctaaattatt tttgtcttct aaatacatat actaatcaac tggaaatgta aatatttgct  18300
aatatttcta ctataggaga attaaagtga gtgaatatgg taccacaagg tttggagatt  18360
taattgttgc aatgctgcat ggatggcata tacaccaaac attcaataat tcttgaggat  18420
aataatggta ccacacaaga tttgaggtgc atgaacgtca cgtggacaaa aggtttagta  18480
atttttcaag acaacaatgt taccacacac aagttttgag gtgcatgcat ggatgccctg  18540
tggaaagttt aaaaatattt tggaaatgat ttgcatggaa gccatgtgta aaaccatgac  18600
atccacttgg aggatgcaat aatgaagaaa actacaaatt tacatgcaac tagttatgca  18660
tgtagtctat ataatgagga ttttgcaata ctttcattca tacacactca ctaagtttta  18720
cacgattata atttcttcat agccagtact gtttaagctt cactgtctct gaatcggcaa  18780
aggtaaacgt atcaattatt ctacaaaccc ttttattttt cttttgaatt accgtcttca  18840
ttggttatat gataacttga taagtaaagc ttcaataatt gaatttgatc tgtgtttttt  18900
tggccttaat actaaatcct tacataagct ttgttgcttc tcctcttgtg agttgagtgt  18960
taagttgtaa taatggttca ctttcagctt tagaagaaac gcgccttcca tggctacaaa  19020
ggaggcttac gttttcccaa ctctcaccga gatcaagaga tctctcccaa aggattgctt  19080
cgaggcttct gtgcctttgt ctctctacta cactgtgaga tgcttggtta ttgctgtggc  19140
tttgaccttc ggattgaact acgctagagc tttgccagag gttgagtctt tctgggcttt  19200
ggatgctgct ttgtgcactg gatatatcct cctccaggga attgtgttct ggggattctt  19260
cactgttgga cacgatgctg gacacggagc tttctctaga taccacctct tgaacttcgt  19320
tgtgggaacc ttcatgcact ctctcatctt gaccccattc gagtcttgga agttgaccca  19380
cagacaccac cacaagaaca ccggaaacat cgatagagat gaggtgttct acccacagag  19440
aaaggctgat gatcacccat tgtccaggaa cttgatcttg gctttgggag ctgcttggct  19500
tgcttatttg gtggagggat tcccaccaag aaaggtgaac cacttcaacc cattcgagcc  19560
actttttgtg agacaagtgt ccgctgtggt tatctctttg ctcgctcact tcttcgttgc  19620
tggactctct atctacttgt ctctccagtt gggacttaag accatggcta tctactacta  19680
```

cggaccagtt ttcgtgttcg gatctatgtt ggtgattacc accttcttgc accacaacga 19740
tgaggagact ccatggtatg ctgattctga gtggacttac gtgaagggaa acttgtcctc 19800
tgtggataga tcttacggtg ctctcatcga taacctctcc cacaacatcg gaactcacca 19860
gatccaccac ctcttcccaa ttatcccaca ctacaagctc aagaaggcta ctgctgcttt 19920
ccaccaagct ttcccagagc ttgtgagaaa gtccgatgag ccaatcatca aggctttctt 19980
cagagtggga aggttgtatg ctaactacgg agtggttgat caagaggcta agctcttcac 20040
tttgaaggag gctaaggctg ctactgaagc tgctgctaag accaagtcta cctgattaat 20100
taatcgacaa gctcgagttt ctccataata atgtgtgagt agttcccaga taagggaatt 20160
agggttccta tagggtttcg ctcatgtgtt gagcatataa gaaaccctta gtatgtattt 20220
gtatttgtaa aatacttcta tcaataaaat ttctaattcc taaaaccaaa atccagtact 20280
aaaatccaga tcccccgaat taattcggcg ttaattcagg gcaaacactg tacggaccgt 20340
ggcctaatag gccggtaccc aactttatta tacatagttg ataattcact ggccggatgt 20400
accgaattcg cggccgcaag cttgtacact agtacgcgtc aattggcgat cgcggatctg 20460
agatgaaacc ggtgattatc agaacctttt atggtctttg tatgcatatg gtaaaaaaac 20520
ttagtttgca atttcctgtt tgttttggta atttgagttt cttttagttg ttgatctgcc 20580
tgctttttgg tttacgtcag actactactg ctgttgttgt ttggtttcct ttctttcatt 20640
ttataaataa ataatccggt tcggtttact ccttgtgact ggctcagttt ggttattgcg 20700
aaatgcgaat ggtaaattga gtaattgaaa ttcgttatta gggttctaag ctgttttaac 20760
agtcactggg ttaatatctc tcgaatcttg catggaaaat gctcttacca ttggttttta 20820
attgaaatgt gctcatatgg gccgtggttt ccaaattaaa taaaactacg atgtcatcga 20880
gaagtaaaat caactgtgtc cacattatca gttttgtgta tacgatgaaa tagggtaatt 20940
caaaatctag cttgatatgc cttttggttc attttaacct tctgtaaaca tttttcaga 21000
ttttgaacaa gtaaatccaa aaaaaaaaaa aaaaaatctc aactcaacac taaattattt 21060
taatgtataa aagatgctta aaacatttgg cttaaaagaa agaagctaaa aacatagaga 21120
actcttgtaa attgaagtat gaaaatatac tgaattgggt attatatgaa tttttctgat 21180
ttaggattca catgatccaa aaaggaaatc cagaagcact aatcagacat tggaagtagg 21240
aatatttcaa aaagtttttt tttttaagt aagtgacaaa agcttttaaa aaatagaaaa 21300
gaaactagta ttaaagttgt aaatttaata aacaaaagaa attttttata tttttcatt 21360
tctttttcca gcatgaggtt atgatggcag gatgtggatt tcattttttt cctttgata 21420
gccttttaat tgatctatta taattgacga aaaaatatta gttaattata gatatatttt 21480
aggtagtatt agcaatttac acttccaaaa gactatgtaa gttgtaaata tgatgcgttg 21540
atctcttcat cattcaatgg ttagtcaaaa aaataaaagc ttaactagta aactaaagta 21600
gtcaaaaatt gtactttagt ttaaaatatt acatgaataa tccaaaacga catttatgtg 21660
aaacaaaaac aatatagatc cattaccctg ttatccctag aggggaaaat tcgaatccaa 21720
aaattacgga tatgaatata ggcatatccg tatccgaatt atccgtttga cagctagcaa 21780
cgattgtaca attgcttctt taaaaaagga agaaagaaag aaagaaaaga atcaacatca 21840
gcgttaacaa acggccccgt tacggcccaa acggtcatat agagtaacgg cgttaagcgt 21900
tgaaagactc ctatcgaaat acgtaaccgc aaacgtgtca tagtcagatc ccctcttcct 21960
tcaccgcctc aaacacaaaa ataatcttct acagcctata tatacaaccc ccccttctat 22020
ctctcctttc tcacaattca tcatctttct ttctctaccc ccaattttaa gaaatcctct 22080
cttctcctct tcattttcaa ggtaaatctc tctctctctc tctctctctg ttattccttg 22140
ttttaattag gtatgtatta ttgctagttt gttaatctgc ttatcttatg tatgccttat 22200
gtgaatatct ttatcttgtt catctcatcc gtttagaagc tataaatttg ttgatttgac 22260
tgtgtatcta cacgtggtta tgtttatatc taatcagata tgaatttctt catattgttg 22320
cgtttgtgtg taccaatccg aaatcgttga tttttttcat ttaatcgtgt agctaattgt 22380
acgtatacat atggatctac gtatcaattg ttcatctgtt tgtgtttgta tgtatacaga 22440
tctgaaaaca tcacttctct catctgattg tgttgttaca tacatagata tagatctgtt 22500
atatcatttt ttttattaat tgtgtatata tatatgtgca tagatctgga ttacatgatt 22560
gtgattattt acatgatttt gttatttacg tatgtatata tgtagatctg gacttttgg 22620
agttgttgac ttgattgtat ttgtgtgtgt atatgtgtgt tctgatcttg atatgttatg 22680
tatgtgcagc tgaaccatgg cggcggcaac aacaacaaca acaacatctt cttcgatctc 22740
cttctccacc aaaccatctc cttcctcctc caaatcacca ttaccaatct ccagattctc 22800
cctcccattc tccctaaacc ccaacaaatc atcctcctcc tcccgccgcc gcggtatcaa 22860
atccagctct ccctcctcca tctccgccgt gctcaacaca accaccaatg tcacaaccac 22920
tccctctcca accaaaccta ccaaacccga aacattcatc tcccgattcg ctccagatca 22980
accccgcaaa ggcgctgata tcctcgtcga agctttagaa cgtcaaggcg tagaaaccgt 23040
attcgcttac cctggaggta catcaatgga gattcaccaa gccttaaccc gctcttcctc 23100
aatccgtaac gtccttcctc gtcacgaaca aggaggtgta ttcgcagcag aaggatacgc 23160
tcgatcctca ggtaaaccag gtatctgtat agccacttca ggtcccggag ctacaaatct 23220
cgttagcgga ttagccgatg cgttgttaga tagtgttcct cttgtagcaa tcacaggaca 23280
agtccctcgt cgtatgattg gtacagatgc gtttcaagag actccgattg ttgaggtaac 23340
gcgttcgatt acgaagcata actatcttgt gatggatgtt gaagatatcc ctaggattat 23400
tgaggaagct ttcttttag ctacttctgg tagacctgga cctgttttgg ttgatgttcc 23460
taaagatatt caacaacagc ttgcgattcc taattgggaa caggctatga gattacctgg 23520
ttatatgtct aggatgccta aacctccgga agattctcat ttggagcaga ttgttaggtt 23580
gatttctgag tctaagaagc ctgtgttgta tgttggtggt ggttgtttga attctagcga 23640
tgaattgggt aggtttgttg agcttacggg gatccctgtt gcgagtacgt tgatggggct 23700
gggatcttat ccttgtgatg atgagttgtc gttacatatg cttggaatgc atgggactgt 23760

```
gtatgcaaat tacgctgtgg agcatagtga tttgttgttg gcgtttgggg taaggtttga  23820
tgatcgtgtc acgggtaagc ttgaggcttt tgctagtagg gctaagattg ttcatattga  23880
tattgactcg gctgagattg ggaagaataa gactcctcat gtgtctgtgt gtggtgatgt  23940
taagctggct ttgcaaggga tgaataaggt tcttgagaac cgagcggagg agcttaagct  24000
tgattttgga gtttggagga atgagttgaa cgtacagaaa cagaagtttc cgttgagctt  24060
taagacgttt ggggaagcta ttcctccaca gtatgcgatt aaggtccttg atgagttgac  24120
tgatggaaaa gccataataa gtactggtgt cgggcaacat caaatgtggg cggcgcagtt  24180
ctacaattac aagaaaccaa ggcagtggct atcatcagga ggccttggag ctatgggatt  24240
tggacttcct gctgcgattg gagcgtctgt tgctaaccct gatgcgatag ttgtggatat  24300
tgacggagat ggaagcttta taatgaatgt gcaagagcta gccactattc gtgtagagaa  24360
tcttccagtg aaggtacttt tattaaacaa ccagcatctt ggcatggtta tgcaatggga  24420
agatcggttc tacaaagcta accgagctca cacatttctc ggggatccgg ctcaggagga  24480
cgagatattc ccgaacatgt tgctgtttgc agcagcttgc gggattccag cggcgagggt  24540
gacaaagaaa gcagatctcc gagaagctat tcagacaatg ctggatacac caggacctta  24600
cctgttggat gtgatttgtc cgcaccaaga acatgtgttg ccgatgatcc cgaatggtgg  24660
cactttcaac gatgtcataa cggaaggaga tggccggatt aaatactgat agggataaca  24720
gggtaatctc gacgagatga aaccggtgat tatcagaacc ttttatggtc tttgtatgca  24780
tatggtaaaa aaacttagtt tgcaatttcc tgtttgtttt ggtaatttga gtttctttta  24840
gttgttgatc tgcctgcttt ttggtttacg tcagactact actgctgttg ttgtttggtt  24900
tcctttcttt cattttataa ataaataatc cggttcggtt tactccttgt gactggctca  24960
gtttggttat tgcgaaatgc gaatggtaaa ttgagtaatt gaaattcgtt attagggttc  25020
taagctgttt taacagtcac tgggttaata tctctcgaat cttgcatgga aaatgctctt  25080
accattggtt tttaattgaa atgtgctcat atgggccgtg gtttccaaat taaataaaac  25140
tacgatgtca tcgagaagta aaatcaactg tgtccacatt atcagttttg tgtatacgat  25200
gaaatagggt aattcaaaat ctagcttgat atgccttttg gttcatttta accttctgta  25260
aacatttttt cagattttga acaagtaaat ccaaaaaaaa aaaaaaaaaa tctcaactca  25320
acactaaatt attttaatgt ataaaagatg cttaaaacat ttggcttaaa agaaagaagc  25380
taaaaacata gagaactctt gtaaattgaa gtatgaaaat atactgaatt gggtattata  25440
tgaatttttc tgatttagga ttcacatgat ccaaaaagga aatccagaag cactaatcag  25500
acattggaag taggaatatt tcaaaaagtt tttttttttt aagtaagtga caaaagcttt  25560
taaaaaatag aaaagaaact agtattaaag ttgtaaattt aataaacaaa agaaattttt  25620
tatatttttt catttctttt tccagcatga ggttatgatg gcaggatgtg gatttcattt  25680
ttttcctttt gatagccttt taattgatct attataattg acgaaaaaat attagttaat  25740
tatagatata ttttaggtag tattagcaat ttacacttcc aaaagactat gtaagttgta  25800
aatatgatgc gttgatctct tcatcattca atggttagtc aaaaaaataa aagcttaact  25860
agtaaactaa agtagtcaaa aattgtactt tagtttaaaa tattacatga ataatccaaa  25920
acgacattta tgtgaaacaa aaacaatatg tcgaggcgat cgcagtactt aatcagtgat  25980
cagtaactaa attcagtaca ttaaagacgt ccgcaatgtg ttattaagtt gtctaagcgt  26040
caatttgttt acaccacaat atatcctgcc accagccagc caacagctcc ccgaccggca  26100
gctcggcaca aaatcactga tcatctaaaa aggtgatgtg tatttgagta aaacagcttg  26160
cgtcatgcgg tcgctgcgta tatgatgcga tgagtaaata aacaaatacg caaggggaac  26220
gcatgaaggt tatcgctgta cttaaccaga aaggcgggtc aggcaagacg accatcgcaa  26280
cccatctagc ccgcgccctg caactcgccg gggccgatgt tctgttagtc gattccgatc  26340
cccagggcag tgcccgcgat tgggcggccg tgcgggaaga tcaaccgcta accgttgtcg  26400
gcatcgaccg cccgacgatt gaccgcgacg tgaaggccat cggccggcgc gacttcgtag  26460
tgatcgacgg agcgccccag gcggcggact tggctgtgtc cgcgatcaag gcagccgact  26520
tcgtgctgat tccggtgcag ccaagccctt acgacatttg ggccaccgcc gacctggtgg  26580
agctggttaa gcagcgcatt gaggtcacgg atggaaggct acaagcggcc tttgtcgtgt  26640
cgcgggcgat caaaggcacg cgcatcggcg gtgaggttgc cgaggcgctg gccgggtacg  26700
agctgcccat tcttgagtcc cgtatcacgc agcgcgtgag ctacccaggc actgccgccg  26760
ccggcacaac cgttcttgaa tcagaacccg agggcgacgc tgcccgcgag gtccaggcgc  26820
tggccgctga aattaaatca aaactcattt gagttaatga ggtaaagaga aaatgagcaa  26880
aagcacaaac acgctaagtg ccggccgtcc gagcgcacgc agcagcaagg ctgcaacgtt  26940
ggccagcctg gcagacacgc cagccatgaa gcgggtcaac tttcagttgc cggcggagga  27000
tcacaccaag ctgaagatgt acgcggtacg ccaaggcaag accattaccg agctgctatc  27060
tgaatacatc gcgcagctac cagagtaaat gagcaaatga ataaatgagt agatgaattt  27120
tagcggctaa aggaggcggc atggaaaatc aagaacaacc aggcaccgac gccgtggaat  27180
gccccatgtg tggaggaacg ggcggttggc caggcgtaag cggctgggtt gtctgccggc  27240
cctgcaatgg cactggaacc cccaagcccg aggaatcggc gtgagcggtc gcaaaccatc  27300
cggcccggta caaatcggcg cggcgctggg tgatgacctg gtggagaagt tgaaggccgc  27360
gcaggccgcc cagcggcaac gcatcgaggc agaagcacgc cccggtgaat cgtggcaagg  27420
ggccgctgat cgaatccgca aagaatcccg gcaaccgccg gcagccggtg cgccgtcgat  27480
taggaagccg cccaagggcg acgagcaacc agattttttc gttccgatgc tctatgacgt  27540
gggcacccgc gatagtcgca gcatcatgga cgtggccgtt ttccgtctgt cgaagcgtga  27600
ccgacgagct ggcgaggtga tccgctacga gcttccagac gggcacgtag aggtttccgc  27660
aggccccgcc ggcatggcca gtgtgtggga ttacgacctg gtactgatgg cggtttccca  27720
tctaaccgaa tccatgaacc gataccggga agggaaggga gacaagcccg gccgcgtgtt  27780
ccgtccacac gttgcggacg tactcaagtt ctgccggcga gccgatggcg gaaagcagaa  27840
```

agacgacctg gtagaaacct gcattcggtt aaacaccacg cacgttgcca tgcagcgtac 27900
caagaaggcc aagaacggcc gcctggtgac ggtatccgag ggtgaagcct tgattagccg 27960
ctacaagatc gtaaagagcg aaaccgggcg gccggagtac atcgagatcg agcttgctga 28020
ttggatgtac cgcgagatca cagaaggcaa gaacccggac gtgctgacgg ttcaccccga 28080
ttactttttg atcgaccccg gcatcggccg ttttctctac cgcctggcac gccgcgccgc 28140
aggcaaggca gaagccagat ggttgttcaa gacgatctac gaacgcagtg gcagcgccgg 28200
agagttcaag aagttctgtt tcaccgtgcg caagctgatc gggtcaaatg acctgccgga 28260
gtacgatttg aaggaggagg cggggcaggc tggcccgatc ctagtcatgc gctaccgcaa 28320
cctgatcgag ggcgaagcat ccgccggttc ctaatgtacg gagcagatgc tagggcaaat 28380
tgccctagca ggggaaaaag gtcgaaaagg tctctttcct gtggatagca cgtacattgg 28440
gaacccaaag ccgtacattg ggaaccggaa cccgtacatt gggaacccaa agccgtacat 28500
tgggaaccgg tcacacatgt aagtgactga tataaaagag aaaaaaggcg atttttccgc 28560
ctaaaactct ttaaaactta ttaaaactct taaaacccgc ctggcctgtg cataactgtc 28620
tggccagcgc acagccgaag agctgcaaaa agcgcctacc cttcggtcgc tgcgctccct 28680
acgccccgcc gcttcgcgtc ggcctatcgc ggcctatgcg gtgtgaaata ccgcacagat 28740
gcgtaaggag aaaataccgc atcaggcgct cttccgcttc ctcgctcact gactcgctgc 28800
gctcggtcgt tcggctgcgg cgagcggtat cagctcactc aaaggcggta atacggttat 28860
ccacagaatc aggggataac gcaggaaaga acatgtgagc aaaaggccag caaaaggcca 28920
ggaaccgtaa aaaggccgcg ttgctggcgt ttttccatag gctccgcccc cctgacgagc 28980
atcacaaaaa tcgacgctca agtcagaggt ggcgaaaccc gacaggacta taaagatacc 29040
aggcgtttcc ccctggaagc tccctcgtgc gctctcctgt tccgaccctg ccgcttaccg 29100
gatacctgtc cgcctttctc ccttcgggaa gcgtggcgct ttctcatagc tcacgctgta 29160
ggtatctcag ttcggtgtag gtcgttcgct ccaagctggg ctgtgtgcac gaaccccccg 29220
ttcagcccga ccgctgcgcc ttatccggta actatcgtct tgagtccaac ccggtaagac 29280
acgacttatc gccactggca gcagccactg gtaacaggat tagcagagcg aggtatgtag 29340
gcggtgctac agagttcttg aagtggtggc ctaactacgg ctacactaga aggacagtat 29400
ttggtatctg cgctctgctg aagccagtta ccttcggaaa aagagttggt agctcttgat 29460
ccggcaaaca aaccaccgct ggtagcggtg gtttttttgt ttgcaagcag cagattacgc 29520
gcagaaaaaa aggatctcaa gaagatcctt tgatcttttc tacggggtcc ttcaactcat 29580
cgatagtttg gctgtgagca attatgtgct tagtgcatct aacgcttgag ttaagccgcg 29640
ccgcgaagcg gcgtcggctt gaacgaattt ctagctagac attatttgcc aacgaccttc 29700
gtgatctcgc ccttgacata gtggacaaat tcttcgagct ggtcggcccg ggacgcgaga 29760
cggtcttctt cttggcccag ataggcttgg cgcgcttcga ggatcacggg ctggtattgc 29820
gccggaaggc gctccatcgc ccagtcggcg gcgacatcct tcggcgcgat cttgccggta 29880
accgccgagt accaaatccg gctcagcgta aggaccacat tgcgctcatc gcccgcccaa 29940
tccggcgggg agttccacag ggtcagcgtc tcgttcagtg cttcgaacag atcctgttcc 30000
ggcaccgggt cgaaaagttc ctcggccgcg gggccgacga gggccacgct atgctcccgg 30060
gccttggtga gcaggatcgc cagatcaatg tcgatggtgg ccggttcaaa gatacccgcc 30120
agaatatcat tacgctgcca ttcgccgaac tggagttcgc gtttggccgg atagcgccag 30180
gggatgatgt catcgtgcac cacaatcgtc acctcaaccg cgcgcaggat ttcgctctcg 30240
ccgggggagg cggacgtttc cagaaggtcg ttgataagcg cgcggcgcgt ggtctcgtcg 30300
agacggacgg taacggtgac aagcaggtcg atgtccgaat ggggcttaag gccgccgtca 30360
acggcgctac catacagatg cacggcgagg agggtcggtt cgaggtggcg ctcgatgaca 30420
cccacgactt ccgacagctg ggtggacacc tcggcgatga ccgcttcacc catgatgttt 30480
aactttgttt tagggcgact gccctgctgc gtaacatcgt tgctgctcca taacatcaaa 30540
catcgaccca cggcgtaacg cgcttgctgc ttggatgccc gaggcataga ctgtacccca 30600
aaaaaacagt cataacaagc catgaaaacc gccactgcgt tccatgaata ttcaaacaaa 30660
cacatacagc gcgacttatc atggata 30687

<210> 7
<211> 24750
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 7
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc 240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa 300
gcttggccac taaggccaat ttaaatctac taggccggcc attagcagat atttggtgtc 360
taaatgttta ttttgtgata tgttcatgtt tgaaatggtg gtttcgaaac cagggacaac 420
gttgggatct gatagggtgt caaagagtat tatggattgg gacaatttcg gtcatgagtt 480
gcaaattcaa gtatatcgtt cgattatgaa aattttcgaa gaatatccca tttgagagag 540
tctttacctc attaatgttt ttagattatg aaattttatc atagttcatc gtagtctttt 600

```
tggtgtaaag gctgtaaaaa gaaattgttc acttttgttt tcgtttatgt gaaggctgta    660
aaagattgta aaagactatt ttggtgtttt ggataaaatg atagttttta tagattcttt    720
tgcttttaga agaaatacat ttgaaatttt ttccatgttg agtataaaat accgaaatcg    780
attgaagatc atagaaatat tttaactgaa aacaaattta taactgattc aattctctcc    840
atttttatac ctatttaacc gtaatcgatt ctaatagatg atcgattttt tatataatcc    900
taattaacca acggcatgta ttggataatt aaccgatcaa ctctcacccc taatagaatc    960
agtattttcc ttcgacgtta attgatccta cactatgtag gtcatatcca tcgttttaat   1020
ttttggccac cattcaattc tgtcttgcct ttagggatgt gaatatgaac ggccaaggta   1080
agagaataaa aataatccaa attaaagcaa gagaggccaa gtaagataat ccaaatgtac   1140
acttgtcatt gccaaaatta gtaaaatact cggcatattg tattcccaca cattattaaa   1200
ataccgtata tgtattggct gcatttgcat gaataatact acgtgtaagc ccaaaagaac   1260
ccacgtgtag cccatgcaaa gttaacactc acgaccccat tcctcagtct ccactatata   1320
aacccaccat ccccaatctc accaaaccca ccacacaact cacaactcac tctcacacct   1380
taaagaacca atcaccacca aaaaaccgcg ccaccatgct tgttcttttc ggaaacttct   1440
acgtgaagca gtactctcaa aagaacggaa agcctgagaa cggtgctact cctgaaaacg   1500
gtgcaaagcc tcaaccttgt gagaacggaa ctgttgagaa gagggagaac gataccgcta   1560
atgttagacc tactagacca gctggacctc ctcctgctac ttactacgat tctctcgctg   1620
tttctggaca gggaaaagag agacttttca ccaccgacga agttagaagg cacatcctcc   1680
ctactgacgg atggcttact tgtcacgagg gagtttacga cgttactgac ttccttgcaa   1740
aacaccctgg tggaggtgtt atcactcttg gactcggaag agattgcact atcctcatcg   1800
agtcttacca ccctgctggt agacctgata aggtgatgga aaagtaccgt atcggaactc   1860
ttcaagaccc taagactttc tacgcttggg gagagtctga tttctaccct gagcttaaga   1920
gaagggctct tgctagactt aaagaggctg gacaagctag aagaggtgga cttggagtta   1980
aggctctcct tgttcttact ctcttcttcg tgtcttggta tatgtgggtt gcacacaagt   2040
ctttcttgtg ggctgctgtt tggggattcg ctggatcaca tgtgggactt tctatccagc   2100
acgacggaaa ccacggtgct ttctctagaa acaccctcgt taacagactt gctggatggg   2160
gaatggatct tatcggagct tcttctactg tttgggagta ccagcacgtt atcggacacc   2220
accagtacac taacctcgtt tctgataccc ttttcagcct tcctgagaac gatcctgatg   2280
tgttctcttc ttaccctctc atgagaatgc accctgatac tgcttggcaa cctcaccaca   2340
gattccagca ccttttcgct ttccctttgt tcgctctcat gaccatctct aaggttctca   2400
cctctgattt cgctgtttgc ctctctatga agaagggatc tatcgattgc tctagcagac   2460
ttgttcctct tgagggacaa cttcttttct ggggtgctaa acttgctaac ttcctcctcc   2520
aaatcgttct tccttgttac cttcacggaa ctgctatggg acttgctctt ttctctgttg   2580
ctcaccttgt ttctggtgag taccttgcta tctgcttcat catcaaccac atctctgagt   2640
cttgtgagtt catgaacacc tcattccaaa ctgctgctag aagaactgag atgcttcaag   2700
ctgctcatca agctgctgag gctaagaagg ttaagcctac tcctcctcct aacgattggg   2760
ctgttactca agttcagtgc tgtgttaact ggcgttctgg tggagttctt gctaaccacc   2820
tttctggtgg acttaaccac cagatcgagc accacctctt cccttctatc tctcacgcta   2880
actaccctac tatcgctcct gttgtgaaag aagtgtgcga ggaatacgga cttccttaca   2940
agaactacgt gaccttctgg gatgctgttt gtggaatggt tcagcacctt agacttatgg   3000
gtgctcctcc tgttcctact aacggtgaca aaaaaagttg atgattaatt aataattgat   3060
tgctgcttta atgagatatg cgagacgcct atgatcgcat gatatttgct ttcaattctg   3120
ttgtgcacgt tgtaaaaaac ctgagcatgt gtagctcaga tccttaccgc cggtttcggt   3180
tcattctaat gaatatatca cccgttacta tcgtattttt atgaataata ttctccgttc   3240
aatttactga ttgtggcgcc tactaccggt aattcccggg attagcggcc gctagtctgt   3300
gcgcacttgt atcctgcagg tcaatcgttt aaacactgta cggaccgtgg cctaataggc   3360
cggtacccaa gtttgtacaa aaaagcaggc tccatgatta cgccaagctt ggccactaag   3420
gccaatttaa atctactagg ccggccaaag ctttacaacg ctacacaaaa cttataaccg   3480
taatcaccat tcattaactt aactactatc acatgcattc atgaattgaa acgagaagga   3540
tgtaaatagt tgggaagtta tctccacgtt gaagagatcg ttagcgagag ctgaaagacc   3600
gagggaggag acgccgtcaa cacggacaga gtcgtcgacc ctcacatgaa gtaggaggaa   3660
tctccgtgag gagccagaga gacgtctttg gtcttcggtt tcgatccttg atctgacgga   3720
gaagacgaga gaagtgcgac tggactccgt gaggaccaac agagtcgtcc tcggtttcga   3780
tcgtcggtat tggtggagaa ggcggaggaa tctccgtgac gagccagaga gatgtcgtcg   3840
gtcttcggtt tcgatccttg atctgacgga gaagacgaga gaagtgcgac gagactccgt   3900
gaggaccaac agagttgtcc tcggtttcga tcgtcggttt cggcggagaa ggcggaggaa   3960
tctccgtgag gagccagaga gacgtcgttg gtcttcggtt tcgatccttg atctgttgga   4020
gaagacgaga caagtgggac gagactcaac gacggagtca gagacgtcgt cggtcttcgg   4080
tttcggccga gaaggcggag tcggtcttcg gtttcggccg agaaggcgga ggagacgtct   4140
tcgatttggg tctctcctct tgacgaagaa aacaaagaac acgagaaata atgagaaaga   4200
gaacaaaaga aaaaaaaata aaaataaaaa taaaatttgg tcctcttatg tggtgacacg   4260
tggtttgaaa cccaccaaat aatcgatcac aaaaaaccta agttaaggat cggtaataac   4320
ctttctaatt aattttgatt tatattaaat cactcttttt atttataaac cccactaaat   4380
tatgcgatat tgattgtcta agtacaaaaa ttctctcgaa ttcaatacac atgtttcata   4440
tatttagccc tgttcattta atattactag cgcattttta atttaaaatt ttgtaaactt   4500
ttttggtcaa agaacatttt tttaattaga gacagaaatc tagactcttt atttggaata   4560
atagtaataa agatatatta ggcaatgagt ttatgatgtt atgtttatat agtttatttc   4620
attttaaatt gaaaagcatt atttttatcg aaatgaatct agtatacaat caatatttat   4680
```

gtttttcat cagatacttt cctatttttt ggcacctttc atcggactac tgatttattt 4740
caatgtgtat gcatgcatga gcatgagtat acacatgtct tttaaaatgc atgtaaagcg 4800
taacggacca caaaagagga tccatacaaa tacatctcat cgcttcctct actattctcc 4860
gacacacaca ctgagcatgg tgcttaaaca ctctggtgag ttctagtact tctgctatga 4920
tcgatctcat taccatttct taaatttctc tccctaaata ttccgagttc ttgatttttg 4980
ataacttcag gttttctctt tttgataaat ctggtctttc cattttttt tttttgtggt 5040
taatttagtt tcctatgttc ttcgattgta ttatgcatga tctgtgtttg gattctgtta 5100
gattatgtat tggtgaatat gtatgtgttt ttgcatgtct ggttttggtc ttaaaaatgt 5160
tcaaatctga tgatttgatt gaagcttttt tagtgttggt ttgattcttc tcaaaactac 5220
tgttaattta ctatcatgtt ttccaacttt gattcatgat gacacttttg ttctgctttg 5280
ttataaaatt ttggttggtt tgattttgta attatagtgt aattttgtta ggaatgaaca 5340
tgttttaata ctctgttttc gatttgtcac acattcgaat tattaatcga taatttaact 5400
gaaaattcat ggttctagat cttgttgtca tcagattatt tgtttcgata attcatcaaa 5460
tatgtagtcc ttttgctgat ttgcgactgt ttcatttttt ctcaaaattg tttttgtta 5520
agtttatcta acagttatcg ttgtcaaaag tctctttcat tttgcaaaat cttcttttt 5580
tttttgtttg taactttgtt ttttaagcta cacatttagt ctgtaaaata gcatcgagga 5640
acagttgtct tagtagactt gcatgttctt gtaacttcta tttgtttcag tttgttgatg 5700
actgctttga ttttgtaggt caaaccgcgc catgtctgct agcggagctt tgttgcctgc 5760
tatagctttc gctgcttacg cttacgctac ctacgcttat gctttcgagt ggagccacgc 5820
taacggaatc gataacgtgg atgctagaga gtggattgga gctttgtctt tgagactccc 5880
tgcaattgca accacaatgt acctcttgtt ctgccttgtg ggacctagat tgatggctaa 5940
gagggaggct tttgatccta agggatttat gctcgcttac aacgcttacc aaaccgcttt 6000
caacgttgtg gtgctcggaa tgttcgctag agagatctct ggattgggac aacctgtttg 6060
gggatctact atgccttgga gcgataggaa gtccttcaag attttgttgg gagtgtggct 6120
ccactacaac aataagtacc tcgagttgtt ggatactgtg ttcatggtgg ctaggaaaaa 6180
gaccaagcag ctctctttct tgcacgtgta ccaccacgct ttgttgattt gggcttggtg 6240
gcttgtttgt cacctcatgg ctaccaacga ttgcatcgat gcttatttcg gagctgcttg 6300
caactctttc atccacatcg tgatgtactc ctactacctc atgtctgctt tgggaattag 6360
gtgccccttgg aagagatata tcacccaggc tcagatgttg caattcgtga tcgtgttcgc 6420
tcacgctgtt ttcgtgctca gacaaaagca ctgccctgtt actttgcctt gggcacaaat 6480
gttcgtgatg acaaatatgt tggtgctctt cggaaacttc tacctcaagg cttactctaa 6540
caagtctagg ggagatggag cttcttctgt taagcctgct gagactacta gagcaccttc 6600
tgtgagaaga accaggtcaa ggaagatcga ttgatagtta attaactaag tttgatgtat 6660
ctgagtgcca acgtttactt tgtctttcct ttcttttatt ggttatgatt agatgtttac 6720
tatgttctct ctttttcgtt ataaataaag aagttcaatt cttctatagt ttcaaacgcg 6780
attttaagcg tttctattta ggtttacatg atttctttta caaaatcatc tttaaaatac 6840
agtatatttt tagttttcat aaaatattta aagaaatgaa agtttataaa cattcactcc 6900
tattctctaa ttaaggattt gtaaaacaaa aattttgtaa gcatatcgat ttatgcgttt 6960
tgtcttaatt agctcactaa ataataaata atagcttatg ttgtgggact gtttaattac 7020
ctaacttaga actaaaatca actctttgtg ggcgcctact accggtaatt cccgggatac 7080
ctgcaggtta ggccggcctg ctcggcccgg actgtatcca acttgagatc tttgaatctc 7140
tctgttcctt gatgttctga aggagttcta agtgtaatca gaaagcttgt aacatgcttt 7200
gtagactttc tttgatatac tcttgcaatg actgattgaa cctacgtgaa aactgctggt 7260
caagttctaa ccaaattccg tctacggaag gcccaaaatt tattgacatc ttcagtttca 7320
tggacgtgtc ttcaaagttt tataacttct tatcccatca tttttaagtc tagttctgtt 7380
ccgcatagtc ttagatctca aacaaatcta caactcttgt gtcagttctt cttccagaat 7440
caacttgcta catggtgaaa atctggcgtc aagttctgaa cttgtcaatt ttcttaacag 7500
ttagaaaata atctaagtgt ttagaatatt gacttttcca aagcaaagaa gacttttgac 7560
tttcttaata aaacaaactt ctaattctaa catgtcttga tgaaatgtct ttcttgaaat 7620
ttgatcaaga tgcaaaagtc aaagtttgac ttttcagact gcaattgacc attttgcaga 7680
agtgccaatt ccaaaccaaa attgatgata cagtgctgca aacttgatgt catggaagat 7740
cttaacagaa aattcttgaa gactgagagc aaaaattttc atgtacaaca caaactttcc 7800
tgtttttcat agtcgctgta gacacattaa cataaaacac ctgatcattc gaagagtgat 7860
tcttgaagga aatgtgcagt tacctttgtg cagaacttaa gagcaactta cagactcatt 7920
tactaaaata ctacaatcag gaagatttta acaacttaca gaagtattcg gagttaaaga 7980
gcaacacatt aagggcgaca gttaaaatta atgtgttgta accaccacta cgaatagtaa 8040
gtattataag ttaaatgtaa tcatcacatt ataattattg tccttataat taattatgat 8100
aaacatgtat cattaagatt gtcataacca aatagtcctc gacttgattt ttgaattatt 8160
gtattctatg ttacttttct tgtagcctat ataaaaactt tgtaaagcat aattgtatgc 8220
tggaaaaaat actgtaatga attgaataga aattatggta tttcattctc caaaatccat 8280
caatagaaat ttagtacaaa tcgaaagaca aaaatattga cttattttaa attttacaac 8340
aatataaaaa tattgactta ttttaaattt tacaataata taaattttca cctgtcacct 8400
ttagaaatcc accaacaata ttaattctta gataaattat tcttaataat tttgagatct 8460
ctgtaattat ctgatattta ttttatattt gtcagttatt ttcttatgtt ttactgttaa 8520
cccttatatc ttggtcaaac tagaataagt aaatatgagt ttgtgaagga cacattgaca 8580
agatgaaaca ttggtttttt ccttcttcga atgttaaagg taataaaaca ttcagaatat 8640
tgacctacta ttaatataga tcctttgtct tttaaaaaag tgtgcatgaa aatgctctta 8700
ggtaagctag tgtctcttgc agggctgtgt atatcaattc catttccaga tggttgtaac 8760

tgccactacc tataattagt cataagacac gtatgttaac acacgtcccc atgcatgttt 8820
tttgccatat attcccacac tttctttttc ttcacgtata aaacattgaa ctaattaata 8880
gtccgatcaa gctgaacacc atggcttcta catctgctgc tcaagacgct gctccttacg 8940
agttcccttc tctcactgag atcaagaggg ctcttccttc tgagtgtttc gaggcttctg 9000
ttcctctttc tctctactac accgctagat ctcttgctct tgctggatct ctcgctgttg 9060
ctctctctta cgctagagct ttgcctcttg ttcaggctaa cgctcttctt gatgctactc 9120
tctgcactgg atacgttctt ctccagggaa tcgttttctg ggattcttc accgttggtc 9180
acgattgtgg acacggagct ttctctagat ctcacgtgct caacttctct gttggaaccc 9240
tcatgcactc tatcatcctt accccttttcg agtcttggaa gctctctcac agacaccacc 9300
acaagaacac cggaaacatc gataaggacg agatcttcta ccctcaaaga gaggctgatt 9360
ctcaccctgt ttctagacac cttgtgatgt ctcttggatc tgcttggttc gcttaccttt 9420
tcgctggatt ccctcctaga accatgaacc acttcaaccc ttgggaggct atgtatgtta 9480
gaagagtggc tgctgtgatc atctctctcg gagttctttt cgctttcgct ggactctact 9540
cttacctcac cttcgttctt ggattcacca ctatggctat ctactacttc ggacctctct 9600
tcatcttcgc taccatgctt gttgttacca ctttcctcca ccacaacgat gaggagacac 9660
cttggtacgc tgattctgag tggacttacg tgaagggaaa cctctcttct gtggacagat 9720
cttacggtgc tctcatcgac aaccttagcc acaacatcgg aactcaccag atccaccacc 9780
tcttccctat catccctcac tacaagctca acgatgctac tgctgctttc gctaaggctt 9840
tccctgagct tgttaggaaa aacgctgctc ctatcatccc aactttcttc aggatggctg 9900
ctatgtacgc taagtacgga gttgttgaca ctgatgctaa gaccttcact ctcaaggagg 9960
ctaaggctgc tgctaagact aagtcatctt gatgattaat taaggccgcc tcgaccgtac 10020
cccctgcaga tagactatac tatgttttag cctgcctgct ggctagctac tatgttatgt 10080
tatgttgtaa aataaacacc tgctaaggta tatctatcta tattttagca tggctttctc 10140
aataaattgt ctttccttat cgtttactat cttataccta ataatgaaat aataatatca 10200
catatgagga acggggcagg tttaggcata tatatacgag tgtagggcgg agtgggggc 10260
gcctaccggt atcggtccga ttgcggccgc tagtctgtgc gcacttgtat cctgcaggtt 10320
aggccggcca ctgcagcaaa tttacacatt gccactaaac gtctaaaccc ttgtaatttg 10380
tttttgtttt actatgtgtg ttatgtattt gatttgcgat aaatttttat atttggtact 10440
aaatttataa caccttttat gctaacgttt gccaacactt agcaatttgc aagttgatta 10500
attgattcta aattattttt gtcttctaaa tacatatact aatcaactgg aaatgtaaat 10560
atttgctaat atttctacta taggagaatt aaagtgagtg aatatggtac cacaaggttt 10620
ggagatttaa ttgttgcaat gctgcatgga tggcatatac accaaacatt caataattct 10680
tgaggataat aatggtacca cacaagattt gaggtgcatg aacgtcacgt ggacaaaagg 10740
tttagtaatt tttcaagaca acaatgttac cacacacaag ttttgaggtg catgcatgga 10800
tgccctgtgg aaagtttaaa aatattttgg aaatgatttg catggaagcc atgtgtaaaa 10860
ccatgacatc cacttggagg atgcaataat gaagaaaact acaaatttac atgcaactag 10920
ttatgcatgt agtctatata atgaggattt tgcaatactt tcattcatac acactcacta 10980
agttttacac gattataatt tcttcatagc cagtagggtt tcgtttttgt ttcatcgata 11040
aactcaaagg tgatgatttt agggtcttgt gagtgtgctt ttttgtttga ttctactgta 11100
gggtttatgt tctttagctc ataggttttg tgtatttctt agaaatgtgg cttctttaat 11160
ctctgggttt gtgacttttt gtgtggtttc tgtgtttttc atatcaaaaa cctatttttt 11220
ccgagttttt ttttacaaat tcttactctc aagcttgaat acttcacatg cagtgttctt 11280
ttgtagattt tagagttaat gtgttaaaaa gtttggattt ttcttgctta tagagcttct 11340
tcactttgat tttgtgggtt tttttgtttt aaaggtgaga tttttgatga ggtttttgct 11400
tcaaagatgt cacctttctg ggtttgtctt ttgaataaag ctatgaactg tcacatggct 11460
gacgcaattt tgttactatg tcatgaaagc tgacgttttt ccgtgttata catgtttgct 11520
tacacttgca tgcgtcaaaa aaattggggc tttttagttt tagtcaaaga ttttacttct 11580
cttttgggat ttatgaagga aagttgcaaa ctttctcaaa ttttaccatt tttgctttga 11640
tgtttgttta gattgcgaca gaacaaactc atatatgttg aaatttttgc ttggttttgt 11700
ataggattgt gtcttttgct tataaatgtt gaaatctgaa cttttttttt gtttggtttc 11760
tttgagcagg agataaggcg cgccttccat ggctacaaag gaggcttacg ttttcccaac 11820
tctcaccgag atcaagagat ctctcccaaa ggattgcttc gaggcttctg tgcctttgtc 11880
tctctactac actgtgagat gcttggttat tgctgtggct ttgaccttcg gattgaacta 11940
cgctagagct ttgccagagg ttgagtcttt ctgggctttg gatgctgctt tgtgcactgg 12000
atatatcctc ctccagggaa ttgtgttctg gggattcttc actgttggac acgatgctgg 12060
acacggagct ttctctagat accacctctt gaacttcgtt gtgggaacct tcatgcactc 12120
tctcatcttg accccattcg agtcttggaa gttgacccac agacaccacc acaagaacac 12180
cggaaacatc gatagagatg aggtgttcta cccacagaga aaggctgatg atcacccatt 12240
gtccaggaac ttgatcttgg ctttgggagc tgcttggctt gcttatttgg tggagggatt 12300
cccaccaaga aaggtgaacc acttcaaccc attcgagcca ctttttgtga gacaagtgtc 12360
cgctgtggtt atctctttgc tcgctcactt cttcgttgct ggactctcta tctacttgtc 12420
tctccagttg ggacttaaga ccatggctat ctactactac ggaccagttt tcgtgttcgg 12480
atctatgttg gtgattacca ccttcttgca ccacaacgat gaggagactc catggtatgc 12540
tgattctgag tggacttacg tgaagggaaa cttgtcctct gtggatagat cttacggtgc 12600
tctcatcgat aacctctccc acaacatcgg aactcaccag atccaccacc tcttcccaat 12660
tatcccacac tacaagctca agaaggctac tgctgctttc caccaagctt tcccagagct 12720
tgtgagaaag tccgatgagc caatcatcaa ggctttcttc agagtgggaa ggttgtatgc 12780
taactacgga gtggttgatc aagaggctaa gctcttcact ttgaaggagg ctaaggctgc 12840

tactgaagct gctgctaaga ccaagtctac ctgattaatt aaggccgcag atctccaccg 12900
cggtggcgct ctagcccgat atctcgacaa gctcgagttt ctccataata atgtgtgagt 12960
agttcccaga taagggaatt agggttccta tagggtttcg ctcatgtgtt gagcatataa 13020
gaaaccctta gtatgtattt gtatttgtaa aatacttcta tcaataaaat ttctaattcc 13080
taaaaccaaa atccagtact aaaatccaga tcccccgaat taattcggcg ttaattcagg 13140
gcaaacactg tacggaccgt ggcctaatag gccggtacca cccagctttc ttgtacaaag 13200
tggccatgat tacgccaagc ttggccacta aggccaattt aaatctacta ggccggccta 13260
ctatagaaaa tgtgttatat cgacatgacc agacaaaggg gcaacagtta acaaaacaat 13320
taattctttc atttgagatt aaggaaggta aggtactaaa aagattaaaa aaaatgagct 13380
tatctctttg tttctgtaat aataatataa gtgtgataaa cttttaatat aataattgta 13440
attaggtttt ctacagatga gcaccactca gagacaagat aagaagaaaa caattttgtt 13500
aaacatgatt atagaaactt ttagttaagt cttgaagtat caatataaca aaaaaaagta 13560
cacacgacta tgacaataaa cccactaccg tcaggttatc atttcgatga aatgttttga 13620
tatcattaaa tataacagtc acaaaaaatc atctaattat aacaatataa cttatacata 13680
tatttaacta aaaacttaga gtttttgtaa tgattctaat tgatgattag agtttataga 13740
aatacaatta aataaaaaat ataattttaa aaaaacatag taaagtcaat gagatcctct 13800
ctgacctcag tgatcattta gtcatgtatg tacaacaatc attgttcatc acatgactgt 13860
aaaataaata aggataaact tgggaatata tataatatat tgtattaaat aaaaaaggga 13920
aatacaaata tcaattttag attcccgagt tgacacaact caccatgcac gctgccacct 13980
cagctcccag ctctcgtcac atgtctcatg tcagttaggt ctttggtttt tagtctttga 14040
cacaactcgc catgcatgtt gccacgtgag ctcgttcctc ttcccatgat ctcaccactg 14100
ggcatgcatg ctgccacctc agctggcacc tcttctctat atgtccctag aggccatgca 14160
cagtgccacc tcagcactcc tctcagaacc catacgtacc tgccaatcgg cttctctcca 14220
taaatatcta tttaaattat aactaattat ttcatatact taattgatga cgtggatgca 14280
ttgccatcgt tgtttaataa ttgttaatta cgacatgata aataaaatga aagtaaaaag 14340
tacgaaagat tttccatttg ttgttgtata aatagagaag tgagtgatgc ataatgcatg 14400
aatgcatgac cgcgccacca tgactgttgg atacgatgag gagatcccat tcgagcaagt 14460
tagggctcat aacaagccag atgatgcttg gtgtgctatt catggacacg tgtacgatgt 14520
taccaagttc gcttctgttc atccaggagg agatattatc ttgctcgctg ctggaaagga 14580
agctactgtg ctctacgaga cctaccatgt tagaggagtg tctgatgctg tgctcagaaa 14640
gtacagaatc ggaaagttgc cagatggaca aggaggagct aacgagaagg agaagagaac 14700
cttgtctgga ttgtcctctg cttcttacta cacctggaac tccgatttct acagagtgat 14760
gagggagaga gttgtggcta gattgaagga gagaggaaag gctagaagag gaggatacga 14820
gttgtggatc aaggctttct tgctccttgt tggattctgg tcctctcttt actggatgtg 14880
caccctcgat ccatctttcg gagctatctt ggctgctatg tctttgggag tgttcgctgc 14940
ttttgttgga acctgcatcc aacatgatgg aaaccatgga gctttcgctc aatctagatg 15000
ggttaacaag gtggcaggat ggactttgga tatgatcgga gcttctggaa tgacttggga 15060
gttccaacat gtgttgggac atcacccata cactaacttg atcgaggagg agaacggatt 15120
gcaaaaggtg tccggaaaga agatggatac caagttggct gatcaagagt ctgatccaga 15180
tgtgttctcc acctacccaa tgatgagatt gcatccatgg catcagaaga gatggtatca 15240
caggttccag catatctacg gaccattcat cttcggattc atgaccatca acaaggtggt 15300
gactcaagat gttggagtgg tgttgagaaa gaggctcttc caaatcgatg ctgagtgcag 15360
atatgcttcc ccaatgtacg ttgctaggtt ctggatcatg aaggctttga ccgtgttgta 15420
catggttgct ctcccatgtt atatgcaagg accatggcat ggattgaagc tcttcgctat 15480
cgctcatttc acttgcggag aggttttggc taccatgttc atcgtgaacc acattatcga 15540
gggagtgtct tacgcttcta aggatgctgt taagggaact atggctccac caaagactat 15600
gcatggagtg accccaatga acaacactag aaaggaggtt gaggctgagg cttctaagtc 15660
tggagctgtg gttaagtctg tgccattgga tgattgggct gctgttcaat gccaaacctc 15720
tgtgaactgg tctgttggat cttggttctg gaaccatttc tctggaggac tcaaccatca 15780
aatcgagcat catctcttcc caggattgtc tcacgagacc tactaccaca tccaagatgt 15840
ggttcaatct acctgtgctg agtacggagt tccataccaa catgagccat ctttgtggac 15900
tgcttactgg aagatgctcg aacatttgag acaattggga aacgaggaga ctcacgagtc 15960
ttggcaaaga gctgcttgat taattaacta agactcccaa aaccaccttc cctgtgacag 16020
ttaaaccctg cttatacctt tcctcctaat aatgttcatc tgtcacacaa actaaaataa 16080
ataaaatggg agcaataaat aaaatgggag ctcatatatt tacaccattt acactgtcta 16140
ttattcacca tgccaattat tacttcataa ttttaaaatt atgtcatttt taaaaattgc 16200
ttaatgatgg aaaggattat tataagttaa aagtataaca tagataaact aaccacaaaa 16260
caaatcaata taaactaact tactctccca tctaattttt atttaaattt ctttacactt 16320
ctcttccatt tctatttcta caacattatt taacattttt attgtatttt tcttactttc 16380
taactctatt catttcaaaa atcaatatat gtttatcacc acctctctaa aaaaaacttt 16440
acaatcattg gtccagaaaa gttaaatcac gagatggtca ttttagcatt aaaacaacga 16500
ttcttgtatc actatttttc agcatgtagt ccattctctt caaacaaaga cagcggctat 16560
ataatcgttg tgttatattc agtctaaaac aaggcgccta ctaccggtaa ttcccgggat 16620
tagcggccgc tagtctgtgc gcacttgtat cctgcaggtt aggccggcca aagctttaca 16680
acgctacaca aaacttataa ccgtaatcac cattcattaa cttaactact atcacatgca 16740
ttcatgaatt gaaacgagaa ggatgtaaat agttgggaag ttatctccac gttgaagaga 16800
tcgttagcga gagctgaaag accgagggag gagacgccgt caacacggac agagtcgtcg 16860
accctcacat gaagtaggag gaatctccgt gaggagccag agagacgtct ttggtcttcg 16920

gtttcgatcc ttgatctgac ggagaagacg agagaagtgc gactggactc cgtgaggacc 16980
aacagagtcg tcctcggttt cgatcgtcgg tattggtgga gaaggcggag gaatctccgt 17040
gacgagccag agagatgtcg tcggtcttcg gtttcgatcc ttgatctgac ggagaagacg 17100
agagaagtgc gacgagactc cgtgaggacc aacagagttg tcctcggttt cgatcgtcgg 17160
tttcggcgga gaaggcggag gaatctccgt gaggagccag agagacgtcg ttggtcttcg 17220
gtttcgatcc ttgatctgtt ggagaagacg agacaagtgg gacgagactc aacgacggag 17280
tcagagacgt cgtcggtctt cggtttcggc cgagaaggcg gagtcggtct tcggtttcgg 17340
ccgagaaggc ggaggagacg tcttcgattt gggtctctcc tcttgacgaa gaaaacaaag 17400
aacacgagaa ataatgagaa agagaacaaa agaaaaaaaa ataaaaataa aaataaaatt 17460
tggtcctctt atgtggtgac acgtggtttg aaacccacca aataatcgat cacaaaaaac 17520
ctaagttaag gatcggtaat aacctttcta attaattttg atttatatta aatcactctt 17580
tttatttata aaccccacta aattatgcga tattgattgt ctaagtacaa aaattctctc 17640
gaattcaata cacatgtttc atatatttag ccctgttcat ttaatattac tagcgcattt 17700
ttaatttaaa attttgtaaa ctttttttggt caaagaacat ttttttaatt agagacagaa 17760
atctagactc tttatttgga ataatagtaa taaagatata ttaggcaatg agtttatgat 17820
gttatgttta tatagtttat ttcattttaa attgaaaagc attattttta tcgaaatgaa 17880
tctagtatac aatcaatatt tatgtttttt catcagatac tttcctattt tttggcacct 17940
ttcatcggac tactgattta tttcaatgtg tatgcatgca tgagcatgag tatacacatg 18000
tcttttaaaa tgcatgtaaa gcgtaacgga ccacaaaaga ggatccatac aaatacatct 18060
catcgcttcc tctactattc tccgacacac acactgagca accctaccat gtgtgttgag 18120
accgagaaca acgatggaat ccctactgtg gagatcgctt tcgatggaga gagagaaaga 18180
gctgaggcta acgtgaagtt gtctgctgag aagatggaac ctgctgcttt ggctaagacc 18240
ttcgctagaa gatacgtggt tatcgaggga gttgagtacg atgtgaccga tttcaaacat 18300
cctggaggaa ccgtgatttt ctacgctctc tctaacactg gagctgatgc tactgaggct 18360
ttcaaggagt tccaccacag atctagaaag gctaggaagg ctttggctgc tttgccttct 18420
agacctgcta agaccgctaa agtggatgat gctgagatgc tccaggattt cgctaagtgg 18480
agaaaggagt tggagaggga cggattcttc aagccttctc ctgctcatgt tgcttacaga 18540
ttcgctgagt tggctgctat gtacgctttg ggaacctact tgatgtacgc tagatacgtt 18600
gtgtcctctg tgttggttta cgcttgcttc ttcggagcta gatgtggatg ggttcaacac 18660
gagggaggac actcttcttt gaccggaaac atctggtggg ataagagaat ccaagctttc 18720
actgctggat tcggattggc tggatctgga gatatgtgga actccatgca caacaagcac 18780
cacgctactc ctcaaaaagt gaggcacgat atggatttgg ataccactcc tgctgttgct 18840
ttcttcaaca ccgctgtgga ggataataga cctaggggat tctctaagta ctggctcaga 18900
ttgcaagctt ggaccttcat tcctgtgact tctggattgg tgttgctctt ctggatgttc 18960
ttcctccacc cttctaaggc tttgaaggga ggaaagtacg aggagcttgt gtggatgttg 19020
gctgctcacg tgattagaac ctggaccatt aaggctgtta ctggattcac cgctatgcaa 19080
tcctacggac tcttcttggc tacttcttgg gtttccggat gctacttgtt cgctcacttc 19140
tctacttctc acacccactt ggatgttgtt cctgctgatg agcacttgtc ttgggttagg 19200
tacgctgtgg atcacaccat tgatatcgat ccttctcagg gatgggttaa ctggttgatg 19260
ggatacttga actgccaagt gattcaccac ctcttccctt ctatgcctca attcagacaa 19320
cctgaggtgt ccagaagatt cgttgctttc gctaagaagt ggaacctcaa ctacaaggtg 19380
atgacttatg ctggagcttg gaaggctact ttgggaaacc tcgataatgt gggaaagcac 19440
tactacgtgc acggacaaca ctctggaaag accgcttgat taattaacta agtttgatgt 19500
atctgagtgc caacgtttac tttgtctttc ctttctttta ttggttatga ttagatgttt 19560
actatgttct ctctttttcg ttataaataa agaagttcaa ttcttctata gtttcaaacg 19620
cgattttaag cgtttctatt taggtttaca tgatttcttt tacaaaatca tctttaaaat 19680
acagtatatt tttagttttc ataaaatatt taaagaaatg aaagtttata aacattcact 19740
cctattctct aattaaggat ttgtaaaaca aaaattttgt aagcatatcg atttatgcgt 19800
tttgtcttaa ttagctcact aaataataaa taatagctta tgttgtggga ctgtttaatt 19860
acctaactta gaactaaaat caactctttg tgggcaaaca ctgtacggac cgtggcctaa 19920
taggccggta cccaacttta ttatacatag ttgataattc actggccgga tgtaccgaat 19980
tcgcggccgc aagcttgtac actagtacgc gtcaattggc gatcgcagta cttaatcagt 20040
gatcagtaac taaattcagt acattaaaga cgtccgcaat gtgttattaa gttgtctaag 20100
cgtcaatttg tttacaccac aatatatcct gccaccagcc agccaacagc tccccgaccg 20160
gcagctcggc acaaaatcac tgatcatcta aaaaggtgat gtgtatttga gtaaaacagc 20220
ttgcgtcatg cggtcgctgc gtatatgatg cgatgagtaa ataaacaaat acgcaagggg 20280
aacgcatgaa ggttatcgct gtacttaacc agaaaggcgg gtcaggcaag acgaccatcg 20340
caacccatct agcccgcgcc ctgcaactcg ccggggccga tgttctgtta gtcgattccg 20400
atccccaggg cagtgcccgc gattgggcgg ccgtgcggga agatcaaccg ctaaccgttg 20460
tcggcatcga ccgcccgacg attgaccgcg acgtgaaggc catcggccgg cgcgacttcg 20520
tagtgatcga cggagcgccc caggcggcgg acttggctgt gtccgcgatc aaggcagccg 20580
acttcgtgct gattccggtg cagccaagcc cttacgacat ttgggccacc gccgacctgg 20640
tggagctggt taagcagcgc attgaggtca cggatggaag gctacaagcg gcctttgtcg 20700
tgtcgcgggc gatcaaaggc acgcgcatcg gcggtgaggt tgccgaggcg ctggccgggt 20760
acgagctgcc cattcttgag tcccgtatca cgcagcgcgt gagctaccca ggcactgccg 20820
ccgccggcac aaccgttctt gaatcagaac ccgagggcga cgctgcccgc gaggtccagg 20880
cgctggccgc tgaaattaaa tcaaaactca tttgagttaa tgaggtaaag agaaaatgag 20940
caaaagcaca aacacgctaa gtgccggccg tccgagcgca cgcagcagca aggctgcaac 21000

gttggccagc ctggcagaca cgccagccat gaagcgggtc aactttcagt tgccggcgga 21060
ggatcacacc aagctgaaga tgtacgcggt acgccaaggc aagaccatta ccgagctgct 21120
atctgaatac atcgcgcagc taccagagta aatgagcaaa tgaataaatg agtagatgaa 21180
ttttagcggc taaaggaggc ggcatggaaa atcaagaaca accaggcacc gacgccgtgg 21240
aatgccccat gtgtggagga acgggcggtt ggccaggcgt aagcggctgg gttgtctgcc 21300
ggccctgcaa tggcactgga acccccaagc ccgaggaatc ggcgtgagcg gtcgcaaacc 21360
atccggcccg gtacaaatcg gcgcggcgct gggtgatgac ctggtggaga agttgaaggc 21420
cgcgcaggcc gcccagcggc aacgcatcga ggcagaagca cgccccggtg aatcgtggca 21480
aggggccgct gatcgaatcc gcaaagaatc ccggcaaccg ccggcagccg gtgcgccgtc 21540
gattaggaag ccgcccaagg gcgacgagca accagatttt ttcgttccga tgctctatga 21600
cgtgggcacc cgcgatagtc gcagcatcat ggacgtggcc gttttccgtc tgtcgaagcg 21660
tgaccgacga gctggcgagg tgatccgcta cgagcttcca gacgggcacg tagaggtttc 21720
cgcaggcccc gccggcatgg ccagtgtgtg ggattacgac ctggtactga tggcggtttc 21780
ccatctaacc gaatccatga accgataccg ggaagggaag ggagacaagc ccggccgcgt 21840
gttccgtcca cacgttgcgg acgtactcaa gttctgccgg cgagccgatg gcggaaagca 21900
gaaagacgac ctggtagaaa cctgcattcg gttaaacacc acgcacgttg ccatgcagcg 21960
taccaagaag gccaagaacg gccgcctggt gacggtatcc gagggtgaag ccttgattag 22020
ccgctacaag atcgtaaaga gcgaaaccgg gcggccggag tacatcgaga tcgagcttgc 22080
tgattggatg taccgcgaga tcacagaagg caagaacccg gacgtgctga cggttcaccc 22140
cgattacttt ttgatcgacc ccggcatcgg ccgttttctc taccgcctgg cacgccgcgc 22200
cgcaggcaag gcagaagcca gatggttgtt caagacgatc tacgaacgca gtggcagcgc 22260
cggagagttc aagaagttct gtttcaccgt gcgcaagctg atcgggtcaa atgacctgcc 22320
ggagtacgat ttgaaggagg aggcggggca ggctggcccg atcctagtca tgcgctaccg 22380
caacctgatc gagggcgaag catccgccgg ttcctaatgt acggagcaga tgctagggca 22440
aattgcccta gcaggggaaa aaggtcgaaa aggtctcttt cctgtggata gcacgtacat 22500
tgggaaccca aagccgtaca ttgggaaccg gaacccgtac attgggaacc caaagccgta 22560
cattgggaac cggtcacaca tgtaagtgac tgatataaaa gagaaaaaag gcgatttttc 22620
cgcctaaaac tctttaaaac ttattaaaac tcttaaaacc cgcctggcct gtgcataact 22680
gtctggccag cgcacagccg aagagctgca aaaagcgcct acccttcggt cgctgcgctc 22740
cctacgcccc gccgcttcgc gtcggcctat cgcggcctat gcggtgtgaa ataccgcaca 22800
gatgcgtaag gagaaaatac cgcatcaggc gctcttccgc ttcctcgctc actgactcgc 22860
tgcgctcggt cgttcggctg cggcgagcgg tatcagctca ctcaaaggcg gtaatacggt 22920
tatccacaga atcaggggat aacgcaggaa agaacatgtg agcaaaaggc cagcaaaagg 22980
ccaggaaccg taaaaaggcc gcgttgctgg cgtttttcca taggctccgc ccccctgacg 23040
agcatcacaa aaatcgacgc tcaagtcaga ggtggcgaaa cccgacagga ctataaagat 23100
accaggcgtt tccccctgga agctccctcg tgcgctctcc tgttccgacc ctgccgctta 23160
ccggatacct gtccgccttt ctcccttcgg gaagcgtggc gctttctcat agctcacgct 23220
gtaggtatct cagttcggtg taggtcgttc gctccaagct gggctgtgtg cacgaacccc 23280
ccgttcagcc cgaccgctgc gccttatccg gtaactatcg tcttgagtcc aacccggtaa 23340
gacacgactt atcgccactg gcagcagcca ctggtaacag gattagcaga gcgaggtatg 23400
taggcggtgc tacagagttc ttgaagtggt ggcctaacta cggctacact agaaggacag 23460
tatttggtat ctgcgctctg ctgaagccag ttaccttcgg aaaaagagtt ggtagctctt 23520
gatccggcaa acaaaccacc gctggtagcg gtggtttttt tgtttgcaag cagcagatta 23580
cgcgcagaaa aaaaggatct caagaagatc ctttgatctt ttctacgggg tccttcaact 23640
catcgatagt ttggctgtga gcaattatgt gcttagtgca tctaacgctt gagttaagcc 23700
gcgccgcgaa gcggcgtcgg cttgaacgaa tttctagcta gacattattt gccaacgacc 23760
ttcgtgatct cgcccttgac atagtggaca aattcttcga gctggtcggc ccgggacgcg 23820
agacggtctt cttcttggcc cagataggct tggcgcgctt cgaggatcac gggctggtat 23880
tgcgccggaa ggcgctccat cgcccagtcg gcggcgacat ccttcggcgc gatcttgccg 23940
gtaaccgccg agtaccaaat ccggctcagc gtaaggacca cattgcgctc atcgcccgcc 24000
caatccggcg ggagttccca cagggtcagc gtctcgttca gtgcttcgaa cagatcctgt 24060
tccggcaccg ggtcgaaaag ttcctcggcc gcggggccga cgagggccac gctatgctcc 24120
cgggccttgg tgagcaggat cgccagatca atgtcgatgg tggccggttc aaagataccc 24180
gccagaatat cattacgctg ccattcgccg aactggagtt cgcgtttggc cggatagcgc 24240
caggggatga tgtcatcgtg caccacaatc gtcacctcaa ccgcgcgcag gatttcgctc 24300
tcgccggggg aggcggacgt ttccagaagg tcgttgataa gcgcgcggcg cgtggtctcg 24360
tcgagacgga cggtaacggt gacaagcagg tcgatgtccg aatggggctt aaggccgccg 24420
tcaacggcgc taccatacag atgcacggcg aggagggtcg gttcgaggtg gcgctcgatg 24480
acacccacga cttccgacag ctgggtggac acctcggcga tgaccgcttc acccatgatg 24540
tttaactttg ttttagggcg actgccctgc tgcgtaacat cgttgctgct ccataacatc 24600
aaacatcgac ccacggcgta acgcgcttgc tgcttggatg cccgaggcat agactgtacc 24660
ccaaaaaaac agtcataaca agccatgaaa accgccactg cgttccatga atattcaaac 24720
aaacacatac agcgcgactt atcatggata 24750

<210> 8
<211> 21523
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 8
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc 240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa 300
gcttggccac taaggccaat ttaaatctac taggccggcc attagcagat atttggtgtc 360
taaatgttta ttttgtgata tgttcatgtt tgaaatggtg gtttcgaaac cagggacaac 420
gttgggatct gatagggtgt caaagagtat tatggattgg gacaatttcg gtcatgagtt 480
gcaaattcaa gtatatcgtt cgattatgaa aattttcgaa gaatatccca tttgagagag 540
tctttacctc attaatgttt ttagattatg aaattttatc atagttcatc gtagtctttt 600
tggtgtaaag gctgtaaaaa gaaattgttc acttttgttt tcgtttatgt gaaggctgta 660
aaagattgta aaagactatt ttggtgtttt ggataaaatg atagttttta tagattcttt 720
tgcttttaga agaaatacat ttgaaatttt ttccatgttg agtataaaat accgaaatcg 780
attgaagatc atagaaatat tttaactgaa aacaaattta taactgattc aattctctcc 840
atttttatac ctatttaacc gtaatcgatt ctaatagatg atcgattttt tatataatcc 900
taattaacca acggcatgta ttggataatt aaccgatcaa ctctcacccc taatagaatc 960
agtattttcc ttcgacgtta attgatccta cactatgtag gtcatatcca tcgttttaat 1020
ttttggccac cattcaattc tgtcttgcct ttagggatgt gaatatgaac ggccaaggta 1080
agagaataaa aataatccaa attaaagcaa gagaggccaa gtaagataat ccaaatgtac 1140
acttgtcatt gccaaaatta gtaaaatact cggcatattg tattcccaca cattattaaa 1200
ataccgtata tgtattggct gcatttgcat gaataatact acgtgtaagc ccaaaagaac 1260
ccacgtgtag cccatgcaaa gttaacactc acgaccccat tcctcagtct ccactatata 1320
aacccaccat ccccaatctc accaaaccca ccacacaact cacaactcac tctcacacct 1380
taaagaacca atcaccacca aaaaaccgcg ccaccatgct tgttcttttc ggaaacttct 1440
acgtgaagca gtactctcaa aagaacggaa agcctgagaa cggtgctact cctgaaaacg 1500
gtgcaaagcc tcaaccttgt gagaacggaa ctgttgagaa gagggagaac gataccgcta 1560
atgttagacc tactagacca gctggacctc ctcctgctac ttactacgat tctctcgctg 1620
tttctggaca gggaaaagag agacttttca ccaccgacga agttagaagg cacatcctcc 1680
ctactgacgg atggcttact tgtcacgagg gagtttacga cgttactgac ttccttgcaa 1740
aacaccctgg tggaggtgtt atcactcttg gactcggaag agattgcact atcctcatcg 1800
agtcttacca ccctgctggt agacctgata aggtgatgga aaagtaccgt atcggaactc 1860
ttcaagaccc taagactttc tacgcttggg gagagtctga tttctaccct gagcttaaga 1920
gaagggctct tgctagactt aaagaggctg gacaagctag aagaggtgga cttggagtta 1980
aggctctcct tgttcttact ctcttcttcg tgtcttggta tatgtgggtt gcacacaagt 2040
ctttcttgtg ggctgctgtt tggggattcg ctggatcaca tgtgggactt tctatccagc 2100
acgacggaaa ccacggtgct ttctctagaa acaccctcgt taacagactt gctggatggg 2160
gaatggatct tatcggagct tcttctactg tttgggagta ccagcacgtt atcggacacc 2220
accagtacac taacctcgtt tctgataccc ttttcagcct tcctgagaac gatcctgatg 2280
tgttctcttc ttaccctctc atgagaatgc accctgatac tgcttggcaa cctcaccaca 2340
gattccagca ccttttcgct ttccctttgt tcgctctcat gaccatctct aaggttctca 2400
cctctgattt cgctgtttgc ctctctatga agaagggatc tatcgattgc tctagcagac 2460
ttgttcctct tgagggacaa cttcttttct ggggtgctaa acttgctaac ttcctcctcc 2520
aaatcgttct tccttgttac cttcacggaa ctgctatggg acttgctctt ttctctgttg 2580
ctcaccttgt ttctggtgag taccttgcta tctgcttcat catcaaccac atctctgagt 2640
cttgtgagtt catgaacacc tcattccaaa ctgctgctag aagaactgag atgcttcaag 2700
ctgctcatca agctgctgag gctaagaagg ttaagcctac tcctcctcct aacgattggg 2760
ctgttactca agttcagtgc tgtgttaact ggcgttctgg tggagttctt gctaaccacc 2820
tttctggtgg acttaaccac cagatcgagc accacctctt cccttctatc tctcacgcta 2880
actaccctac tatcgctcct gttgtgaaag aagtgtgcga ggaatacgga cttccttaca 2940
agaactacgt gaccttctgg gatgctgttt gtggaatggt tcagcacctt agacttatgg 3000
gtgctcctcc tgttcctact aacggtgaca aaaaaagttg atgattaatt aataattgat 3060
tgctgcttta atgagatatg cgagacgcct atgatcgcat gatatttgct ttcaattctg 3120
ttgtgcacgt tgtaaaaaac ctgagcatgt gtagctcaga tccttaccgc cggtttcggt 3180
tcattctaat gaatatatca cccgttacta tcgtattttt atgaataata ttctccgttc 3240
aatttactga ttgtggcgcc tactaccggt aattcccggg attagcggcc gctagtctgt 3300
gcgcacttgt atcctgcagg tcaatcgttt aaacactgta cggaccgtgg cctaataggc 3360
cggtacccaa gtttgtacaa aaaagcaggc tccatgatta cgccaagctt ggccactaag 3420
gccaatttaa atctactagg ccggccaaag ctttacaacg ctacacaaaa cttataaccg 3480
taatcaccat tcattaactt aactactatc acatgcattc atgaattgaa acgagaagga 3540
tgtaaatagt tgggaagtta tctccacgtt gaagagatcg ttagcgagag ctgaaagacc 3600
gagggaggag acgccgtcaa cacggacaga gtcgtcgacc ctcacatgaa gtaggaggaa 3660
tctccgtgag gagccagaga gacgtctttg gtcttcggtt tcgatccttg atctgacgga 3720
gaagacgaga gaagtgcgac tggactccgt gaggaccaac agagtcgtcc tcggtttcga 3780

```
tcgtcggtat tggtggagaa ggcggaggaa tctccgtgac gagccagaga gatgtcgtcg   3840
gtcttcggtt tcgatccttg atctgacgga gaagacgaga gaagtgcgac gagactccgt   3900
gaggaccaac agagttgtcc tcggtttcga tcgtcggttt cggcggagaa ggcggaggaa   3960
tctccgtgag gagccagaga gacgtcgttg gtcttcggtt tcgatccttg atctgttgga   4020
gaagacgaga caagtgggac gagactcaac gacggagtca gagacgtcgt cggtcttcgg   4080
tttcggccga gaaggcggag tcggtcttcg gtttcggccg agaaggcgga ggagacgtct   4140
tcgatttggg tctctcctct tgacgaagaa aacaaagaac acgagaaata atgagaaaga   4200
gaacaaaaga aaaaaaaata aaaataaaaa taaaatttgg tcctcttatg tggtgacacg   4260
tggtttgaaa cccaccaaat aatcgatcac aaaaaaccta agttaaggat cggtaataac   4320
ctttctaatt aattttgatt tatattaaat cactcttttt atttataaac cccactaaat   4380
tatgcgatat tgattgtcta agtacaaaaa ttctctcgaa ttcaatacac atgtttcata   4440
tatttagccc tgttcattta atattactag cgcattttta atttaaaatt ttgtaaactt   4500
ttttggtcaa agaacatttt tttaattaga gacagaaatc tagactcttt atttggaata   4560
atagtaataa agatatatta ggcaatgagt ttatgatgtt atgtttatat agtttatttc   4620
attttaaatt gaaaagcatt atttttatcg aaatgaatct agtatacaat caatatttat   4680
gtttttttcat cagatacttt cctatttttt ggcacctttc atcggactac tgatttattt   4740
caatgtgtat gcatgcatga gcatgagtat acacatgtct tttaaaatgc atgtaaagcg   4800
taacggacca caaaagagga tccatacaaa tacatctcat cgcttcctct actattctcc   4860
gacacacaca ctgagcatgg tgcttaaaca ctctggtgag ttctagtact tctgctatga   4920
tcgatctcat taccatttct taaatttctc tccctaaata ttccgagttc ttgattttttg   4980
ataacttcag gtttctcttt tttgataaat ctggtctttc cattttttt tttttgtggt   5040
taatttagtt tcctatgttc ttcgattgta ttatgcatga tctgtgtttg gattctgtta   5100
gattatgtat tggtgaatat gtatgtgttt ttgcatgtct ggttttggtc ttaaaaatgt   5160
tcaaatctga tgatttgatt gaagcttttt tagtgttggt ttgattcttc tcaaaactac   5220
tgttaattta ctatcatgtt ttccaacttt gattcatgat gacacttttg ttctgctttg   5280
ttataaaatt ttggttggtt tgattttgta attatagtgt aattttgtta ggaatgaaca   5340
tgttttaata ctctgttttc gatttgtcac acattcgaat tattaatcga taatttaact   5400
gaaaattcat ggttctagat cttgttgtca tcagattatt tgtttcgata attcatcaaa   5460
tatgtagtcc ttttgctgat ttgcgactgt ttcatttttt ctcaaaattg ttttttgtta   5520
agtttatcta acagttatcg ttgtcaaaag tctctttcat tttgcaaaat cttcttttttt   5580
tttttgtttg taactttgtt ttttaagcta cacatttagt ctgtaaaata gcatcgagga   5640
acagttgtct tagtagactt gcatgttctt gtaacttcta tttgtttcag tttgttgatg   5700
actgctttga ttttgtaggt caaaccgcgc catgtctgct agcggagctt tgttgcctgc   5760
tatagctttc gctgcttacg cttacgctac ctacgcttat gctttcgagt ggagccacgc   5820
taacggaatc gataacgtgg atgctagaga gtggattgga gctttgtctt tgagactccc   5880
tgcaattgca accacaatgt acctcttgtt ctgccttgtg ggacctagat tgatggctaa   5940
gagggaggct tttgatccta agggatttat gctcgcttac aacgcttacc aaaccgcttt   6000
caacgttgtg gtgctcggaa tgttcgctag agagatctct ggattgggac aacctgtttg   6060
gggatctact atgccttgga gcgataggaa gtccttcaag attttgttgg gagtgtggct   6120
ccactacaac aataagtacc tcgagttgtt ggatactgtg ttcatggtgg ctaggaaaaa   6180
gaccaagcag ctctctttct tgcacgtgta ccaccacgct ttgttgattt gggcttggtg   6240
gcttgtttgt cacctcatgg ctaccaacga ttgcatcgat gcttatttcg gagctgcttg   6300
caactctttc atccacatcg tgatgtactc ctactacctc atgtctgctt tgggaattag   6360
gtgcccttgg aagagatata tcacccaggc tcagatgttg caattcgtga tcgtgttcgc   6420
tcacgctgtt ttcgtgctca gacaaaagca ctgccctgtt actttgcctt gggcacaaat   6480
gttcgtgatg acaaatatgt tggtgctctt cggaaacttc tacctcaagg cttactctaa   6540
caagtctagg ggagatggag cttcttctgt taagcctgct gagactacta gagcaccttc   6600
tgtgagaaga accaggtcaa ggaagatcga ttgatagtta attaactaag tttgatgtat   6660
ctgagtgcca acgtttactt tgtctttcct ttcttttatt ggttatgatt agatgtttac   6720
tatgttctct ctttttcgtt ataaataaag aagttcaatt cttctatagt ttcaaacgcg   6780
attttaagcg tttctattta ggtttacatg atttctttta caaaatcatc tttaaaatac   6840
agtatatttt tagttttcat aaaatattta aagaaatgaa agtttataaa cattcactcc   6900
tattctctaa ttaaggattt gtaaaacaaa aattttgtaa gcatatcgat ttatgcgttt   6960
tgtcttaatt agctcactaa ataataaata atagcttatg ttgtgggact gtttaattac   7020
ctaacttaga actaaaatca actctttgtg ggcgcctact accggtaatt cccgggatac   7080
ctgcaggtta ggccggcctg ctcggcccgg actgtatcca acttgagatc tttgaatctc   7140
tctgttcctt gatgttctga aggagttcta agtgtaatca gaaagcttgt aacatgcttt   7200
gtagactttc tttgatatac tcttgcaatg actgattgaa cctacgtgaa aactgctggt   7260
caagttctaa ccaaattccg tctacggaag gcccaaaatt tattgacatc ttcagtttca   7320
tggacgtgtc ttcaaagttt tataacttct tatcccatca tttttaagtc tagttctgtt   7380
ccgcatagtc ttagatctca aacaaatcta caactcttgt gtcagttctt cttccagaat   7440
caacttgcta catggtgaaa atctggcgtc aagttctgaa cttgtcaatt ttcttaacag   7500
ttagaaaata atctaagtgt ttagaatatt gacttttcca aagcaaagaa gacttttgac   7560
tttcttaata aaacaaactt ctaattctaa catgtcttga tgaaatgtct ttcttgaaat   7620
ttgatcaaga tgcaaaagtc aaagtttgac ttttcagact gcaattgacc attttgcaga   7680
agtgccaatt ccaaaccaaa attgatgata cagtgctgca aacttgatgt catggaagat   7740
cttaacagaa aattcttgaa gactgagagc aaaaatttc atgtacaaca caaactttcc   7800
tgtttttcat agtcgctgta gacacattaa cataaaacac ctgatcattc gaagagtgat   7860
```

tcttgaagga aatgtgcagt tacctttgtg cagaacttaa gagcaactta cagactcatt 7920
tactaaaata ctacaatcag gaagatttta acaacttaca gaagtattcg gagttaaaga 7980
gcaacacatt aagggcgaca gttaaaatta atgtgttgta accaccacta cgaatagtaa 8040
gtattataag ttaaatgtaa tcatcacatt ataattattg tccttataat taattatgat 8100
aaacatgtat cattaagatt gtcataacca aatagtcctc gacttgattt ttgaattatt 8160
gtattctatg ttacttttct tgtagcctat ataaaaactt tgtaaagcat aattgtatgc 8220
tggaaaaaat actgtaatga attgaataga aattatggta tttcattctc caaaatccat 8280
caatagaaat ttagtacaaa tcgaaagaca aaaatattga cttattttaa attttacaac 8340
aatataaaaa tattgactta ttttaaattt tacaataata taaattttca cctgtcacct 8400
ttagaaatcc accaacaata ttaattctta gataaattat tcttaataat tttgagatct 8460
ctgtaattat ctgatattta ttttatattt gtcagttatt ttcttatgtt ttactgttaa 8520
cccttatatc ttggtcaaac tagaataagt aaatatgagt ttgtgaagga cacattgaca 8580
agatgaaaca ttggtttttt ccttcttcga atgttaaagg taataaaaca ttcagaatat 8640
tgacctacta ttaatataga tcctttgtct tttaaaaaag tgtgcatgaa aatgctctta 8700
ggtaagctag tgtctcttgc agggctgtgt atatcaattc catttccaga tggttgtaac 8760
tgccactacc tataattagt cataagacac gtatgttaac acacgtcccc atgcatgttt 8820
tttgccatat attcccacac tttctttttc ttcacgtata aaacattgaa ctaattaata 8880
gtccgatcaa gctgaacacc atggcttcta catctgctgc tcaagacgct gctccttacg 8940
agttcccttc tctcactgag atcaagaggg ctcttccttc tgagtgtttc gaggcttctg 9000
ttcctctttc tctctactac accgctagat ctcttgctct tgctggatct ctcgctgttg 9060
ctctctctta cgctagagct ttgcctcttg ttcaggctaa cgctcttctt gatgctactc 9120
tctgcactgg atacgttctt ctccagggaa tcgttttctg ggattcttc accgttggtc 9180
acgattgtgg acacggagct ttctctagat ctcacgtgct caacttctct gttggaaccc 9240
tcatgcactc tatcatcctt accccttttcg agtcttggaa gctctctcac agacaccacc 9300
acaagaacac cggaaacatc gataaggacg agatcttcta ccctcaaaga gaggctgatt 9360
ctcaccctgt ttctagacac cttgtgatgt ctcttggatc tgcttggttc gcttaccttt 9420
tcgctggatt ccctcctaga accatgaacc acttcaaccc ttgggaggct atgtatgtta 9480
gaagagtggc tgctgtgatc atctctctcg gagttctttt cgctttcgct ggactctact 9540
cttacctcac cttcgttctt ggattcacca ctatggctat ctactacttc ggacctctct 9600
tcatcttcgc taccatgctt gttgttacca ctttcctcca ccacaacgat gaggagacac 9660
cttggtacgc tgattctgag tggacttacg tgaagggaaa cctctcttct gtggacagat 9720
cttacggtgc tctcatcgac aaccttagcc acaacatcgg aactcaccag atccaccacc 9780
tcttccctat catccctcac tacaagctca acgatgctac tgctgctttc gctaaggctt 9840
tccctgagct tgttaggaaa aacgctgctc ctatcatccc aactttcttc aggatggctg 9900
ctatgtacgc taagtacgga gttgttgaca ctgatgctaa gaccttcact ctcaaggagg 9960
ctaaggctgc tgctaagact aagtcatctt gatgattaat taaggccgcc tcgaccgtac 10020
cccctgcaga tagactatac tatgttttag cctgcctgct ggctagctac tatgttatgt 10080
tatgttgtaa aataaacacc tgctaaggta tatctatcta tattttagca tggctttctc 10140
aataaattgt ctttccttat cgtttactat cttataccta ataatgaaat aataatatca 10200
catatgagga acggggcagg tttaggcata tatatacgag tgtagggcgg agtgggggc 10260
gcctaccggt atcggtccga ttgcggccgc tagtctgtgc gcacttgtat cctgcaggtt 10320
aggccggcca ctgcagcaaa tttacacatt gccactaaac gtctaaaccc ttgtaatttg 10380
tttttgtttt actatgtgtg ttatgtattt gatttgcgat aaatttttat atttggtact 10440
aaatttataa cacctttat gctaacgttt gccaacactt agcaatttgc aagttgatta 10500
attgattcta aattattttt gtcttctaaa tacatatact aatcaactgg aaatgtaaat 10560
atttgctaat atttctacta taggagaatt aaagtgagtg aatatggtac cacaaggttt 10620
ggagatttaa ttgttgcaat gctgcatgga tggcatatac accaaacatt caataattct 10680
tgaggataat aatggtacca cacaagattt gaggtgcatg aacgtcacgt ggacaaaagg 10740
tttagtaatt tttcaagaca acaatgttac cacacacaag ttttgaggtg catgcatgga 10800
tgccctgtgg aaagtttaaa aatattttgg aaatgatttg catggaagcc atgtgtaaaa 10860
ccatgacatc cacttggagg atgcaataat gaagaaaact acaaatttac atgcaactag 10920
ttatgcatgt agtctatata atgaggattt tgcaatactt tcattcatac acactcacta 10980
agttttacac gattataatt tcttcatagc cagtagggtt tcgtttttgt ttcatcgata 11040
aactcaaagg tgatgatttt agggtcttgt gagtgtgctt ttttgtttga ttctactgta 11100
gggtttatgt tctttagctc ataggttttg tgtatttctt agaaatgtgg cttctttaat 11160
ctctgggttt gtgacttttt gtgtggtttc tgtgtttttc atatcaaaaa cctatttttt 11220
ccgagttttt ttttacaaat tcttactctc aagcttgaat acttcacatg cagtgttctt 11280
ttgtagattt tagagttaat gtgttaaaaa gtttggattt ttcttgctta tagagcttct 11340
tcactttgat tttgtgggtt tttttgtttt aaaggtgaga tttttgatga ggtttttgct 11400
tcaaagatgt cacctttctg ggtttgtctt ttgaataaag ctatgaactg tcacatggct 11460
gacgcaattt tgttactatg tcatgaaagc tgacgttttt ccgtgttata catgtttgct 11520
tacacttgca tgcgtcaaaa aaattggggc tttttagttt tagtcaaaga ttttacttct 11580
cttttgggat ttatgaagga aagttgcaaa ctttctcaaa ttttaccatt tttgctttga 11640
tgtttgttta gattgcgaca gaacaaactc atatatgttg aaatttttgc ttggttttgt 11700
ataggattgt gtcttttgct tataaatgtt gaaatctgaa cttttttttt gtttggtttc 11760
tttgagcagg agataaggcg cgccttccat ggctacaaag gaggcttacg ttttcccaac 11820
tctcaccgag atcaagagat ctctcccaaa ggattgcttc gaggcttctg tgcctttgtc 11880
tctctactac actgtgagat gcttggttat tgctgtggct ttgaccttcg gattgaacta 11940

```
cgctagagct ttgccagagg ttgagtcttt ctgggctttg gatgctgctt tgtgcactgg  12000
atatatcctc ctccagggaa ttgtgttctg ggattcttc  actgttggac acgatgctgg  12060
acacggagct ttctctagat accacctctt gaacttcgtt gtgggaacct tcatgcactc  12120
tctcatcttg accccattcg agtcttggaa gttgacccac agacaccacc acaagaacac  12180
cggaaacatc gatagagatg aggtgttcta cccacagaga aaggctgatg atcacccatt  12240
gtccaggaac ttgatcttgg ctttgggagc tgcttggctt gcttatttgg tggagggatt  12300
cccaccaaga aaggtgaacc acttcaaccc attcgagcca ctttttgtga gacaagtgtc  12360
cgctgtggtt atctctttgc tcgctcactt cttcgttgct ggactctcta tctacttgtc  12420
tctccagttg ggacttaaga ccatggctat ctactactac ggaccagttt tcgtgttcgg  12480
atctatgttg gtgattacca ccttcttgca ccacaacgat gaggagactc catggtatgc  12540
tgattctgag tggacttacg tgaagggaaa cttgtcctct gtggatagat cttacggtgc  12600
tctcatcgat aacctctccc acaacatcgg aactcaccag atccaccacc tcttcccaat  12660
tatcccacac tacaagctca agaaggctac tgctgctttc caccaagctt tcccagagct  12720
tgtgagaaag tccgatgagc caatcatcaa ggctttcttc agagtgggaa ggttgtatgc  12780
taactacgga gtggttgatc aagaggctaa gctcttcact ttgaaggagg ctaaggctgc  12840
tactgaagct gctgctaaga ccaagtctac ctgattaatt aaggccgcag atctccaccg  12900
cggtggcgct ctagcccgat atctcgacaa gctcgagttt ctccataata atgtgtgagt  12960
agttcccaga taagggaatt agggttccta tagggtttcg ctcatgtgtt gagcatataa  13020
gaaaccctta gtatgtattt gtatttgtaa aatacttcta tcaataaaat ttctaattcc  13080
taaaaccaaa atccagtact aaaatccaga tcccccgaat taattcggcg ttaattcagg  13140
gcaaacactg tacggaccgt ggcctaatag gccggtacca cccagctttc ttgtacaaag  13200
tggccatgat tacgccaagc ttggccacta aggccaattt aaatctacta ggccggccta  13260
ctatagaaaa tgtgttatat cgacatgacc agacaaaggg gcaacagtta acaaaacaat  13320
taattctttc atttgagatt aaggaaggta aggtactaaa aagattaaaa aaaatgagct  13380
tatctctttg tttctgtaat aataatataa gtgtgataaa cttttaatat aataattgta  13440
attaggtttt ctacagatga gcaccactca gagacaagat aagaagaaaa caattttgtt  13500
aaacatgatt atagaaactt ttagttaagt cttgaagtat caatataaca aaaaaaagta  13560
cacacgacta tgacaataaa cccactaccg tcaggttatc atttcgatga aatgttttga  13620
tatcattaaa tataacagtc acaaaaaatc atctaattat aacaatataa cttatacata  13680
tatttaacta aaaacttaga gtttttgtaa tgattctaat tgatgattag agtttataga  13740
aatacaatta aataaaaaat ataattttaa aaaaacatag taaagtcaat gagatcctct  13800
ctgacctcag tgatcattta gtcatgtatg tacaacaatc attgttcatc acatgactgt  13860
aaaataaata aggataaact tgggaatata tataatatat tgtattaaat aaaaaaggga  13920
aatacaaata tcaattttag attcccgagt tgacacaact caccatgcac gctgccacct  13980
cagctcccag ctctcgtcac atgtctcatg tcagttaggt ctttggtttt tagtctttga  14040
cacaactcgc catgcatgtt gccacgtgag ctcgttcctc ttcccatgat ctcaccactg  14100
ggcatgcatg ctgccacctc agctggcacc tcttctctat atgtccctag aggccatgca  14160
cagtgccacc tcagcactcc tctcagaacc catacgtacc tgccaatcgg cttctctcca  14220
taaatatcta tttaaattat aactaattat ttcatatact taattgatga cgtggatgca  14280
ttgccatcgt tgtttaataa ttgttaatta cgacatgata aataaaatga aagtaaaaag  14340
tacgaaagat ttttccatttg ttgttgtata aatagagaag tgagtgatgc ataatgcatg  14400
aatgcatgac cgcgccacca tgactgttgg atacgatgag gagatcccat tcgagcaagt  14460
tagggctcat aacaagccag atgatgcttg gtgtgctatt catggacacg tgtacgatgt  14520
taccaagttc gcttctgttc atccaggagg agatattatc ttgctcgctg ctggaaagga  14580
agctactgtg ctctacgaga cctaccatgt tagaggagtg tctgatgctg tgctcagaaa  14640
gtacagaatc ggaaagttgc cagatggaca aggaggagct aacgagaagg agaagagaac  14700
cttgtctgga ttgtcctctg cttcttacta cacctggaac tccgatttct acagagtgat  14760
gagggagaga gttgtggcta gattgaagga gagaggaaag gctagaagag gaggatacga  14820
gttgtggatc aaggctttct tgctccttgt tggattctgg tcctctcttt actggatgtg  14880
caccctcgat ccatctttcg gagctatctt ggctgctatg tctttgggag tgttcgctgc  14940
ttttgttgga acctgcatcc aacatgatgg aaaccatgga gctttcgctc aatctagatg  15000
ggttaacaag gtggcaggat ggactttgga tatgatcgga gcttctggaa tgacttggga  15060
gttccaacat gtgttgggac atcacccata cactaacttg atcgaggagg agaacggatt  15120
gcaaaaggtg tccggaaaga agatggatac caagttggct gatcaagagt ctgatccaga  15180
tgtgttctcc acctacccaa tgatgagatt gcatccatgg catcagaaga gatggtatca  15240
caggttccag catatctacg gaccattcat cttcggattc atgaccatca acaaggtggt  15300
gactcaagat gttggagtgg tgttgagaaa gaggctcttc caaatcgatg ctgagtgcag  15360
atatgcttcc ccaatgtacg ttgctaggtt ctggatcatg aaggctttga ccgtgttgta  15420
catggttgct ctcccatgtt atatgcaagg accatggcat ggattgaagc tcttcgctat  15480
cgctcatttc acttgcggag aggttttggc taccatgttc atcgtgaacc acattatcga  15540
gggagtgtct tacgcttcta aggatgctgt taagggaact atggctccac caaagactat  15600
gcatggagtg accccaatga acaacactag aaaggaggtt gaggctgagg cttctaagtc  15660
tggagctgtg gttaagtctg tgccattgga tgattgggct gctgttcaat gccaaacctc  15720
tgtgaactgg tctgttggat cttggttctg gaaccatttc tctggaggac tcaaccatca  15780
aatcgagcat catctcttcc caggattgtc tcacgagacc tactaccaca tccaagatgt  15840
ggttcaatct acctgtgctg agtacggagt tccataccaa catgagccat ctttgtggac  15900
tgcttactgg aagatgctcg aacatttgag acaattggga aacgaggaga ctcacgagtc  15960
ttggcaaaga gctgcttgat taattaacta agactcccaa aaccaccttc cctgtgacag  16020
```

ttaaaccctg cttatacctt tcctcctaat aatgttcatc tgtcacacaa actaaaataa 16080
ataaaatggg agcaataaat aaaatgggag ctcatatatt tacaccattt acactgtcta 16140
ttattcacca tgccaattat tacttcataa ttttaaaatt atgtcatttt taaaaattgc 16200
ttaatgatgg aaaggattat tataagttaa aagtataaca tagataaact aaccacaaaa 16260
caaatcaata taaactaact tactctccca tctaattttt atttaaattt ctttacactt 16320
ctcttccatt tctatttcta caacattatt taacattttt attgtatttt tcttactttc 16380
taactctatt catttcaaaa atcaatatat gtttatcacc acctctctaa aaaaaacttt 16440
acaatcattg gtccagaaaa gttaaatcac gagatggtca ttttagcatt aaaacaacga 16500
ttcttgtatc actatttttc agcatgtagt ccattctctt caaacaaaga cagcggctat 16560
ataatcgttg tgttatattc agtctaaaac aaggcgccta ctaccggtaa ttcccgggat 16620
tagcggccgc tagtctgtgc gcacttgtat cctgcaggtc aatcgtttaa acactgtacg 16680
gaccgtggcc taataggccg gtacccaact ttattataca tagttgataa ttcactggcc 16740
ggatgtaccg aattcgcggc cgcaagcttg tacactagta cgcgtcaatt ggcgatcgca 16800
gtacttaatc agtgatcagt aactaaattc agtacattaa agacgtccgc aatgtgttat 16860
taagttgtct aagcgtcaat ttgtttacac cacaatatat cctgccacca gccagccaac 16920
agctccccga ccggcagctc ggcacaaaat cactgatcat ctaaaaaggt gatgtgtatt 16980
tgagtaaaac agcttgcgtc atgcggtcgc tgcgtatatg atgcgatgag taaataaaca 17040
aatacgcaag gggaacgcat gaaggttatc gctgtactta accagaaagg cgggtcaggc 17100
aagacgacca tcgcaaccca tctagcccgc gccctgcaac tcgccggggc cgatgttctg 17160
ttagtcgatt ccgatcccca gggcagtgcc cgcgattggg cggccgtgcg ggaagatcaa 17220
ccgctaaccg ttgtcggcat cgaccgcccg acgattgacc gcgacgtgaa ggccatcggc 17280
cggcgcgact tcgtagtgat cgacggagcg ccccaggcgg cggacttggc tgtgtccgcg 17340
atcaaggcag ccgacttcgt gctgattccg gtgcagccaa gcccttacga catttgggcc 17400
accgccgacc tggtggagct ggttaagcag cgcattgagg tcacggatgg aaggctacaa 17460
gcggcctttg tcgtgtcgcg ggcgatcaaa ggcacgcgca tcggcggtga ggttgccgag 17520
gcgctggccg ggtacgagct gcccattctt gagtcccgta tcacgcagcg cgtgagctac 17580
ccaggcactg ccgccgccgg cacaaccgtt cttgaatcag aacccgaggg cgacgctgcc 17640
cgcgaggtcc aggcgctggc cgctgaaatt aaatcaaaac tcatttgagt taatgaggta 17700
aagagaaaat gagcaaaagc acaaacacgc taagtgccgg ccgtccgagc gcacgcagca 17760
gcaaggctgc aacgttggcc agcctggcag acacgccagc catgaagcgg gtcaactttc 17820
agttgccggc ggaggatcac accaagctga agatgtacgc ggtacgccaa ggcaagacca 17880
ttaccgagct gctatctgaa tacatcgcgc agctaccaga gtaaatgagc aaatgaataa 17940
atgagtagat gaattttagc ggctaaagga ggcggcatgg aaaatcaaga acaaccaggc 18000
accgacgccg tggaatgccc catgtgtgga ggaacgggcg gttggccagg cgtaagcggc 18060
tgggttgtct gccggccctg caatggcact ggaaccccca agcccgagga atcggcgtga 18120
gcggtcgcaa accatccggc ccggtacaaa tcggcgcggc gctgggtgat gacctggtgg 18180
agaagttgaa ggccgcgcag gccgcccagc ggcaacgcat cgaggcagaa gcacgccccg 18240
gtgaatcgtg gcaagggggc gctgatcgaa tccgcaaaga atcccggcaa ccgccggcag 18300
ccggtgcgcc gtcgattagg aagccgccca agggcgacga gcaaccagat tttttcgttc 18360
cgatgctcta tgacgtgggc acccgcgata gtcgcagcat catggacgtg gccgttttcc 18420
gtctgtcgaa gcgtgaccga cgagctggcg aggtgatccg ctacgagctt ccagacgggc 18480
acgtagaggt ttccgcaggc cccgccggca tggccagtgt gtgggattac gacctggtac 18540
tgatggcggt ttcccatcta accgaatcca tgaaccgata ccgggaaggg aagggagaca 18600
agcccggccg cgtgttccgt ccacacgttg cggacgtact caagttctgc cggcgagccg 18660
atggcggaaa gcagaaagac gacctggtag aaacctgcat tcggttaaac accacgcacg 18720
ttgccatgca gcgtaccaag aaggccaaga acggccgcct ggtgacggta tccgagggtg 18780
aagccttgat tagccgctac aagatcgtaa agagcgaaac cgggcggccg gagtacatcg 18840
agatcgagct tgctgattgg atgtaccgcg agatcacaga aggcaagaac ccggacgtgc 18900
tgacggttca ccccgattac tttttgatcg accccggcat cggccgtttt ctctaccgcc 18960
tggcacgccg cgccgcaggc aaggcagaag ccagatggtt gttcaagacg atctacgaac 19020
gcagtggcag cgccggagag ttcaagaagt tctgtttcac cgtgcgcaag ctgatcgggt 19080
caaatgacct gccggagtac gatttgaagg aggaggcggg gcaggctggc ccgatcctag 19140
tcatgcgcta ccgcaacctg atcgagggcg aagcatccgc cggttcctaa tgtacggagc 19200
agatgctagg gcaaattgcc ctagcagggg aaaaaggtcg aaaaggtctc tttcctgtgg 19260
atagcacgta cattgggaac ccaaagccgt acattgggaa ccggaacccg tacattggga 19320
acccaaagcc gtacattggg aaccggtcac acatgtaagt gactgatata aaagagaaaa 19380
aaggcgattt ttccgcctaa aactctttaa aacttattaa aactcttaaa acccgcctgg 19440
cctgtgcata actgtctggc cagcgcacag ccgaagagct gcaaaaagcg cctacccttc 19500
ggtcgctgcg ctccctacgc cccgccgctt cgcgtcggcc tatcgcggcc tatgcggtgt 19560
gaaataccgc acagatgcgt aaggagaaaa taccgcatca ggcgctcttc cgcttcctcg 19620
ctcactgact cgctgcgctc ggtcgttcgg ctgcggcgag cggtatcagc tcactcaaag 19680
gcggtaatac ggttatccac agaatcaggg gataacgcag gaaagaacat gtgagcaaaa 19740
ggccagcaaa aggccaggaa ccgtaaaaag gccgcgttgc tggcgttttt ccataggctc 19800
cgcccccctg acgagcatca caaaaatcga cgctcaagtc agaggtggcg aaacccgaca 19860
ggactataaa gataccaggc gtttccccct ggaagctccc tcgtgcgctc tcctgttccg 19920
accctgccgc ttaccggata cctgtccgcc tttctccctt cgggaagcgt ggcgctttct 19980
catagctcac gctgtaggta tctcagttcg gtgtaggtcg ttcgctccaa gctgggctgt 20040
gtgcacgaac cccccgttca gcccgaccgc tgcgccttat ccggtaacta tcgtcttgag 20100

tccaacccgg taagacacga cttatcgcca ctggcagcag ccactggtaa caggattagc 20160
agagcgaggt atgtaggcgg tgctacagag ttcttgaagt ggtggcctaa ctacggctac 20220
actagaagga cagtatttgg tatctgcgct ctgctgaagc cagttacctt cggaaaaaga 20280
gttggtagct cttgatccgg caaacaaacc accgctggta gcggtggttt ttttgtttgc 20340
aagcagcaga ttacgcgcag aaaaaaagga tctcaagaag atcctttgat cttttctacg 20400
gggtccttca actcatcgat agtttggctg tgagcaatta tgtgcttagt gcatctaacg 20460
cttgagttaa gccgcgccgc gaagcggcgt cggcttgaac gaatttctag ctagacatta 20520
tttgccaacg accttcgtga tctcgccctt gacatagtgg acaaattctt cgagctggtc 20580
ggcccgggac gcgagacggt cttcttcttg gcccagatag gcttggcgcg cttcgaggat 20640
cacgggctgg tattgcgccg gaaggcgctc catcgcccag tcggcggcga catccttcgg 20700
cgcgatcttg ccggtaaccg ccgagtacca aatccggctc agcgtaagga ccacattgcg 20760
ctcatcgccc gcccaatccg gcggggagtt ccacagggtc agcgtctcgt tcagtgcttc 20820
gaacagatcc tgttccggca ccgggtcgaa aagttcctcg gccgcggggc cgacgagggc 20880
cacgctatgc tcccgggcct tggtgagcag gatcgccaga tcaatgtcga tggtggccgg 20940
ttcaaagata cccgccagaa tatcattacg ctgccattcg ccgaactgga gttcgcgttt 21000
ggccggatag cgccagggga tgatgtcatc gtgcaccaca atcgtcacct caaccgcgcg 21060
caggatttcg ctctcgccgg gggaggcgga cgtttccaga aggtcgttga taagcgcgcg 21120
gcgcgtggtc tcgtcgagac ggacggtaac ggtgacaagc aggtcgatgt ccgaatgggg 21180
cttaaggccg ccgtcaacgg cgctaccata cagatgcacg gcgaggaggg tcggttcgag 21240
gtggcgctcg atgacaccca cgacttccga cagctgggtg gacacctcgg cgatgaccgc 21300
ttcacccatg atgtttaact ttgttttagg gcgactgccc tgctgcgtaa catcgttgct 21360
gctccataac atcaaacatc gacccacggc gtaacgcgct tgctgcttgg atgcccgagg 21420
catagactgt accccaaaaa aacagtcata acaagccatg aaaaccgcca ctgcgttcca 21480
tgaatattca aacaaacaca tacagcgcga cttatcatgg ata 21523

<210> 9
<211> 21639
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 9
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc 240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa 300
gcttggccac taaggccaat ttaaatctac taggccggcc tgctcggccc ggactgtatc 360
caacttgaga tctttgaatc tctctgttcc ttgatgttct gaaggagttc taagtgtaat 420
cagaaagctt gtaacatgct ttgtagactt tctttgatat actcttgcaa tgactgattg 480
aacctacgtg aaaactgctg gtcaagttct aaccaaattc cgtctacgga aggcccaaaa 540
tttattgaca tcttcagttt catggacgtg tcttcaaagt tttataactt cttatcccat 600
catttttaag tctagttctg ttccgcatag tcttagatct caaacaaatc tacaactctt 660
gtgtcagttc ttcttccaga atcaacttgc tacatggtga aaatctggcg tcaagttctg 720
aacttgtcaa ttttcttaac agttagaaaa taatctaagt gtttagaata ttgacttttc 780
caaagcaaag aagacttttg actttcttaa taaaacaaac ttctaattct aacatgtctt 840
gatgaaatgt ctttcttgaa atttgatcaa gatgcaaaag tcaaagtttg acttttcaga 900
ctgcaattga ccattttgca gaagtgccaa ttccaaacca aaattgatga tacagtgctg 960
caaacttgat gtcatggaag atcttaacag aaaattcttg aagactgaga gcaaaaattt 1020
tcatgtacaa cacaaacttt cctgtttttc atagtcgctg tagacacatt aacataaaac 1080
acctgatcat tcgaagagtg attcttgaag gaaatgtgca gttacctttg tgcagaactt 1140
aagagcaact tacagactca tttactaaaa tactacaatc aggaagattt taacaactta 1200
cagaagtatt cggagttaaa gagcaacaca ttaagggcga cagttaaaat taatgtgttg 1260
taaccaccac tacgaatagt aagtattata agttaaatgt aatcatcaca ttataattat 1320
tgtccttata attaattatg ataaacatgt atcattaaga ttgtcataac caaatagtcc 1380
tcgacttgat ttttgaatta ttgtattcta tgttactttt cttgtagcct atataaaaac 1440
tttgtaaagc ataattgtat gctggaaaaa atactgtaat gaattgaata gaaattatgg 1500
tatttcattc tccaaaatcc atcaatagaa atttagtaca aatcgaaaga caaaaatatt 1560
gacttatttt aaattttaca acaatataaa aatattgact tattttaaat tttacaataa 1620
tataaatttt cacctgtcac ctttagaaat ccaccaacaa tattaattct tagataaatt 1680
attcttaata attttgagat ctctgtaatt atctgatatt tattttatat ttgtcagtta 1740
ttttcttatg ttttactgtt aacccttata tcttggtcaa actagaataa gtaaatatga 1800
gtttgtgaag gacacattga caagatgaaa cattggtttt ttccttcttc gaatgttaaa 1860
ggtaataaaa cattcagaat attgacctac tattaatata gatcctttgt cttttaaaaa 1920
agtgtgcatg aaaatgctct taggtaagct agtgtctctt gcagggctgt gtatatcaat 1980
tccatttcca gatggttgta actgccacta cctataatta gtcataagac acgtatgtta 2040

```
acacacgtcc ccatgcatgt tttttgccat atattcccac actttctttt tcttcacgta   2100
taaaacattg aactaattaa tagtccgatc aagctgaaca ccgcgccacc atgatcacta   2160
ctactcacag agttcacgag gctccagtta agactagact taccgctgtt gctgatgtta   2220
ggcctatccc tgacgttaag acccttaagg acgctatccc tgctaagtgc ttcgagagat   2280
ctatgttgag atctttcagc tacgttgtta gggatctcat cgttgttttc tcccttttct   2340
acgctgctgt tccactttct agacttgacg ctccttggtt tgttactgtt cctctttggg   2400
ctctctactc tttcgttcag ggatgcttct tcactggact ttggattctt gctcacgatt   2460
gcggacacga ttctttctct gaaaacctca ccgttaacgc tatcactgga tggttccttc   2520
actgcatgct tatggtgcct ttcttctcct ggaaattctc tcacgctaga caccacagat   2580
accacaacca catggataag gataccgttt tcgttcctca cagaaagtct gacgtggagg   2640
ccaagaaaac taagcctact ctcctcgaga agatcatgga tcactctgct gctgatactc   2700
ctatcatcac cgttgcttct cttatcttcc accaagttct tggatggcct gcttacattc   2760
ttatgaacgc tggtgctgga aagaagtctc ttaccaaggg agataggtac acctcttcta   2820
ggtacaagca gtctcacctt gatcctactg ctcacgtttt cactccatct gaggctccat   2880
tcgttgcttt gtctaatgtt ggactcatcc ttactatgac cgctctctat gtttggtcaa   2940
gatctgttgg aacctctacc gttcttcttg cttacggact tccttacctt tggatgaatc   3000
actggatcgt tgctatcact taccttcacc acactcaccc tgaggctcct cactacgagg   3060
ctgataactg gactttcatc aagggtgctg cttcaactgt tgatagggac ttcggattca   3120
tcggtagaca tatcttccac ggaattatcg agtaccacgt tgttcaccac atgttcccta   3180
gaatcccatt ctaccacgct gaggaagcta cttgggctat cgctccactt cttggagagc   3240
gttacatcca gcaaaagacc aacttcttcg gagatctttg gcagtctttc actacttgca   3300
agactgttga gcctggaact ggtgttcacg caggtggact tgtttggtct aagaccaagg   3360
ctaagaagga tgctaagaag tccgactgat agttaattaa ggccgcctcg accgtacccc   3420
ctgcagatag actatactat gttttagcct gcctgctggc tagctactat gttatgttat   3480
gttgtaaaat aaacacctgc taaggtatat ctatctatat tttagcatgg ctttctcaat   3540
aaattgtctt tccttatcgt ttactatctt atacctaata atgaaataat aatatcacat   3600
atgaggaacg gggcaggttt aggcatatat atacgagtgt agggcggagt ggggggcgcc   3660
tactaccggt aattcccggg attagcggcc gctagtctgt gcgcacttgt atcctgcagg   3720
tcaatcgttt aaacactgta cggaccgtgg cctaataggc cggtacccaa gtttgtacaa   3780
aaaagcaggc tccatgatta cgccaagctt ggccactaag gccaatttaa atctactagg   3840
ccggccaaag ctttacaacg ctacacaaaa cttataaccg taatcaccat tcattaactt   3900
aactactatc acatgcattc atgaattgaa acgagaagga tgtaaatagt tgggaagtta   3960
tctccacgtt gaagagatcg ttagcgagag ctgaaagacc gagggaggag acgccgtcaa   4020
cacggacaga gtcgtcgacc ctcacatgaa gtaggaggaa tctccgtgag gagccagaga   4080
gacgtctttg gtcttcggtt tcgatccttg atctgacgga gaagacgaga gaagtgcgac   4140
tggactccgt gaggaccaac agagtcgtcc tcggtttcga tcgtcggtat tggtggagaa   4200
ggcggaggaa tctccgtgac gagccagaga gatgtcgtcg gtcttcggtt tcgatccttg   4260
atctgacgga gaagacgaga gaagtgcgac gagactccgt gaggaccaac agagttgtcc   4320
tcggtttcga tcgtcggttt cggcggagaa ggcggaggaa tctccgtgag gagccagaga   4380
gacgtcgttg gtcttcggtt tcgatccttg atctgttgga gaagacgaga caagtgggac   4440
gagactcaac gacggagtca gagacgtcgt cggtcttcgg tttcggccga gaaggcggag   4500
tcggtcttcg gtttcggccg agaaggcgga ggagacgtct tcgatttggg tctctcctct   4560
tgacgaagaa aacaaagaac acgagaaata atgagaaaga gaacaaaaga aaaaaaaata   4620
aaaataaaaa taaaatttgg tcctcttatg tggtgacacg tggtttgaaa cccaccaaat   4680
aatcgatcac aaaaaaccta agttaaggat cggtaataac ctttctaatt aattttgatt   4740
tatattaaat cactcttttt atttataaac ccactaaat tatgcgatat tgattgtcta   4800
agtacaaaaa ttctctcgaa ttcaatacac atgtttcata tatttagccc tgttcattta   4860
atattactag cgcattttta atttaaaatt ttgtaaactt ttttggtcaa agaacatttt   4920
tttaattaga gacagaaatc tagactcttt atttggaata atagtaataa agatatatta   4980
ggcaatgagt ttatgatgtt atgtttatat agtttatttc attttaaatt gaaaagcatt   5040
atttttatcg aaatgaatct agtatacaat caatatttat gtttttttcat cagatacttt   5100
cctatttttt ggcacctttc atcggactac tgatttattt caatgtgtat gcatgcatga   5160
gcatgagtat acacatgtct tttaaaatgc atgtaaagcg taacggacca caaaagagga   5220
tccatacaaa tacatctcat cgcttcctct actattctcc gacacacaca ctgagcatgg   5280
tgcttaaaca ctctggtgag ttctagtact tctgctatga tcgatctcat taccatttct   5340
taaatttctc tccctaaata ttccgagttc ttgatttttg ataacttcag gttttctctt   5400
tttgataaat ctggtctttc catttttttt tttttgtggt taatttagtt tcctatgttc   5460
ttcgattgta ttatgcatga tctgtgtttg gattctgtta gattatgtat tggtgaatat   5520
gtatgtgttt ttgcatgtct ggttttggtc ttaaaaatgt tcaaatctga tgatttgatt   5580
gaagcttttt tagtgttggt ttgattcttc tcaaaactac tgttaattta ctatcatgtt   5640
ttccaacttt gattcatgat gacacttttg ttctgctttg ttataaaatt ttggttggtt   5700
tgattttgta attatagtgt aattttgtta ggaatgaaca tgttttaata ctctgttttc   5760
gatttgtcac acattcgaat tattaatcga taatttaact gaaaattcat ggttctagat   5820
cttgttgtca tcagattatt tgtttcgata attcatcaaa tatgtagtcc ttttgctgat   5880
ttgcgactgt ttcatttttt ctcaaaattg ttttttgtta agtttatcta acagttatcg   5940
ttgtcaaaag tctctttcat tttgcaaaat cttctttttt tttttgtttg taactttgtt   6000
ttttaagcta cacatttagt ctgtaaaata gcatcgagga acagttgtct tagtagactt   6060
gcatgttctt gtaacttcta tttgtttcag tttgttgatg actgctttga ttttgtaggt   6120
```

```
caaaccgcgc catgtctgct agcggagctt tgttgcctgc tatagctttc gctgcttacg   6180
cttacgctac ctacgcttat gctttcgagt ggagccacgc taacggaatc gataacgtgg   6240
atgctagaga gtggattgga gctttgtctt tgagactccc tgcaattgca accacaatgt   6300
acctcttgtt ctgccttgtg ggacctagat tgatggctaa gagggaggct tttgatccta   6360
agggatttat gctcgcttac aacgcttacc aaaccgcttt caacgttgtg gtgctcggaa   6420
tgttcgctag agagatctct ggattgggac aacctgtttg gggatctact atgccttgga   6480
gcgataggaa gtccttcaag attttgttgg gagtgtggct ccactacaac aataagtacc   6540
tcgagttgtt ggatactgtg ttcatggtgg ctaggaaaaa gaccaagcag ctctctttct   6600
tgcacgtgta ccaccacgct ttgttgattt gggcttggtg gcttgtttgt cacctcatgg   6660
ctaccaacga ttgcatcgat gcttatttcg gagctgcttg caactctttc atccacatcg   6720
tgatgtactc ctactacctc atgtctgctt tgggaattag gtgcccttgg aagagatata   6780
tcacccaggc tcagatgttg caattcgtga tcgtgttcgc tcacgctgtt ttcgtgctca   6840
gacaaaagca ctgccctgtt actttgcctt gggcacaaat gttcgtgatg acaaatatgt   6900
tggtgctctt cggaaacttc tacctcaagg cttactctaa caagtctagg ggagatggag   6960
cttcttctgt taagcctgct gagactacta gagcaccttc tgtgagaaga accaggtcaa   7020
ggaagatcga ttgatagtta attaactaag tttgatgtat ctgagtgcca acgtttactt   7080
tgtctttcct ttcttttatt ggttatgatt agatgtttac tatgttctct ctttttcgtt   7140
ataaataaag aagttcaatt cttctatagt ttcaaacgcg attttaagcg tttctattta   7200
ggtttacatg atttctttta caaaatcatc tttaaaatac agtatatttt tagttttcat   7260
aaaatattta aagaaatgaa agtttataaa cattcactcc tattctctaa ttaaggattt   7320
gtaaaacaaa aattttgtaa gcatatcgat ttatgcgttt tgtcttaatt agctcactaa   7380
ataataaata atagcttatg ttgtgggact gtttaattac ctaacttaga actaaaatca   7440
actctttgtg ggcgcctact accggtaatt cccgggatta gcggccgcta gtctgtgcgc   7500
acttgtatcc tgcaggttag gccggccact gcagcaaatt tacacattgc cactaaacgt   7560
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa   7620
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag   7680
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa   7740
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa   7800
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac   7860
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa   7920
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt   7980
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca   8040
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac   8100
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc   8160
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtagggtttc   8220
gtttttgttt catcgataaa ctcaaaggtg atgattttag ggtcttgtga gtgtgctttt   8280
ttgtttgatt ctactgtagg gtttatgttc tttagctcat aggttttgtg tatttcttag   8340
aaatgtggct tctttaatct ctgggtttgt gactttttgt gtggtttctg tgtttttcat   8400
atcaaaaacc tattttttcc gagttttttt ttacaaattc ttactctcaa gcttgaatac   8460
ttcacatgca gtgttctttt gtagatttta gagttaatgt gttaaaaagt ttggattttt   8520
cttgcttata gagcttcttc actttgattt tgtgggtttt tttgttttaa aggtgagatt   8580
tttgatgagg tttttgcttc aaagatgtca cctttctggg tttgtctttt gaataaagct   8640
atgaactgtc acatggctga cgcaattttg ttactatgtc atgaaagctg acgtttttcc   8700
gtgttataca tgtttgctta cacttgcatg cgtcaaaaaa attggggctt tttagtttta   8760
gtcaaagatt ttacttctct tttgggattt atgaaggaaa gttgcaaact ttctcaaatt   8820
ttaccatttt tgctttgatg tttgtttaga ttgcgacaga acaaactcat atatgttgaa   8880
atttttgctt ggttttgtat aggattgtgt cttttgctta taaatgttga aatctgaact   8940
tttttttgt ttggtttctt tgagcaggag ataaggcgcg ccttccatgg ctacaaagga   9000
ggcttacgtt ttcccaactc tcaccgagat caagagatct ctcccaaagg attgcttcga   9060
ggcttctgtg cctttgtctc tctactacac tgtgagatgc ttggttattg ctgtggcttt   9120
gaccttcgga ttgaactacg ctagagcttt gccagaggtt gagtctttct gggctttgga   9180
tgctgctttg tgcactggat atatcctcct ccagggaatt gtgttctggg gattcttcac   9240
tgttggacac gatgctggac acggagcttt ctctagatac cacctcttga acttcgttgt   9300
gggaaccttc atgcactctc tcatcttgac cccattcgag tcttggaagt tgacccacag   9360
acaccaccac aagaacaccg gaaacatcga tagagatgag gtgttctacc cacagagaaa   9420
ggctgatgat cacccattgt ccaggaactt gatcttggct ttgggagctg cttggcttgc   9480
ttatttggtg gagggattcc caccaagaaa ggtgaaccac ttcaacccat tcgagccact   9540
ttttgtgaga caagtgtccg ctgtggttat ctctttgctc gctcacttct tcgttgctgg   9600
actctctatc tacttgtctc tccagttggg acttaagacc atggctatct actactacgg   9660
accagttttc gtgttcggat ctatgttggt gattaccacc ttcttgcacc acaacgatga   9720
ggagactcca tggtatgctg attctgagtg gacttacgtg aagggaaact tgtcctctgt   9780
ggatagatct tacggtgctc tcatcgataa cctctcccac aacatcggaa ctcaccagat   9840
ccaccacctc ttcccaatta tcccacacta caagctcaag aaggctactg ctgctttcca   9900
ccaagctttc ccagagcttg tgagaaagtc cgatgagcca atcatcaagg ctttcttcag   9960
agtgggaagg ttgtatgcta actacggagt ggttgatcaa gaggctaagc tcttcacttt  10020
gaaggaggct aaggctgcta ctgaagctgc tgctaagacc aagtctacct gattaattaa  10080
ggccgcagat ctccaccgcg gtggcgctct agcccgatat ctcgacaagc tcgagtttct  10140
ccataataat gtgtgagtag ttcccagata agggaattag ggttcctata gggtttcgct  10200
```

catgtgttga gcatataaga aacccttagt atgtatttgt atttgtaaaa tacttctatc 10260
aataaaattt ctaattccta aaaccaaaat ccagtactaa aatccagatc ccccgaatta 10320
attcggcgtt aattcagggc aaacactgta cggaccgtgg cctaataggc cggtaccacc 10380
cagctttctt gtacaaagtg gccatgatta cgccaagctt ggccactaag gccaatttaa 10440
atctactagg ccggcctact atagaaaatg tgttatatcg acatgaccag acaaaggggc 10500
aacagttaac aaaacaatta attctttcat ttgagattaa ggaaggtaag gtactaaaaa 10560
gattaaaaaa aatgagctta tctctttgtt tctgtaataa taatataagt gtgataaact 10620
tttaatataa taattgtaat taggttttct acagatgagc accactcaga gacaagataa 10680
gaagaaaaca attttgttaa acatgattat agaaactttt agttaagtct tgaagtatca 10740
atataacaaa aaaaagtaca cacgactatg acaataaacc cactaccgtc aggttatcat 10800
ttcgatgaaa tgttttgata tcattaaata taacagtcac aaaaaatcat ctaattataa 10860
caatataact tatacatata tttaactaaa aacttagagt ttttgtaatg attctaattg 10920
atgattagag tttatagaaa tacaattaaa taaaaaatat aattttaaaa aaacatagta 10980
aagtcaatga gatcctctct gacctcagtg atcatttagt catgtatgta caacaatcat 11040
tgttcatcac atgactgtaa aataaataag gataaacttg ggaatatata taatatattg 11100
tattaaataa aaaagggaaa tacaaatatc aattttagat tcccgagttg acacaactca 11160
ccatgcacgc tgccacctca gctcccagct ctcgtcacat gtctcatgtc agttaggtct 11220
ttggttttta gtctttgaca caactcgcca tgcatgttgc cacgtgagct cgttcctctt 11280
cccatgatct caccactggg catgcatgct gccacctcag ctggcacctc ttctctatat 11340
gtccctagag gccatgcaca gtgccacctc agcactcctc tcagaaccca tacgtacctg 11400
ccaatcggct tctctccata aatatctatt taaattataa ctaattattt catatactta 11460
attgatgacg tggatgcatt gccatcgttg tttaataatt gttaattacg acatgataaa 11520
taaaatgaaa gtaaaaagta cgaaagattt tccatttgtt gttgtataaa tagagaagtg 11580
agtgatgcat aatgcatgaa tgcatgaccg cgccaccatg actgttggat acgatgagga 11640
gatcccattc gagcaagtta gggctcataa caagccagat gatgcttggt gtgctattca 11700
tggacacgtg tacgatgtta ccaagttcgc ttctgttcat ccaggaggag atattatctt 11760
gctcgctgct ggaaaggaag ctactgtgct ctacgagacc taccatgtta gaggagtgtc 11820
tgatgctgtg ctcagaaagt acagaatcgg aaagttgcca gatggacaag gaggagctaa 11880
cgagaaggag aagagaacct tgtctggatt gtcctctgct tcttactaca cctggaactc 11940
cgatttctac agagtgatga gggagagagt tgtggctaga ttgaaggaga gaggaaaggc 12000
tagaagagga ggatacgagt tgtggatcaa ggctttcttg ctccttgttg gattctggtc 12060
ctctctttac tggatgtgca ccctcgatcc atctttcgga gctatcttgg ctgctatgtc 12120
tttgggagtg ttcgctgctt ttgttggaac ctgcatccaa catgatggaa accatggagc 12180
tttcgctcaa tctagatggg ttaacaaggt ggcaggatgg actttggata tgatcggagc 12240
ttctggaatg acttgggagt tccaacatgt gttgggacat cacccataca ctaacttgat 12300
cgaggaggag aacggattgc aaaaggtgtc cggaaagaag atggatacca agttggctga 12360
tcaagagtct gatccagatg tgttctccac ctacccaatg atgagattgc atccatggca 12420
tcagaagaga tggtatcaca ggttccagca tatctacgga ccattcatct tcggattcat 12480
gaccatcaac aaggtggtga ctcaagatgt tggagtggtg ttgagaaaga ggctcttcca 12540
aatcgatgct gagtgcagat atgcttcccc aatgtacgtt gctaggttct ggatcatgaa 12600
ggctttgacc gtgttgtaca tggttgctct cccatgttat atgcaaggac catggcatgg 12660
attgaagctc ttcgctatcg ctcatttcac ttgcggagag gttttggcta ccatgttcat 12720
cgtgaaccac attatcgagg gagtgtctta cgcttctaag gatgctgtta agggaactat 12780
ggctccacca aagactatgc atggagtgac ccaatgaac aacactagaa aggaggttga 12840
ggctgaggct tctaagtctg gagctgtggt taagtctgtg ccattggatg attgggctgc 12900
tgttcaatgc caaacctctg tgaactggtc tgttggatct tggttctgga accatttctc 12960
tggaggactc aaccatcaaa tcgagcatca tctcttccca ggattgtctc acgagaccta 13020
ctaccacatc caagatgtgg ttcaatctac ctgtgctgag tacggagttc cataccaaca 13080
tgagccatct ttgtggactg cttactggaa gatgctcgaa catttgagac aattgggaaa 13140
cgaggagact cacgagtctt ggcaaagagc tgcttgatta attaactaag actcccaaaa 13200
ccaccttccc tgtgacagtt aaaccctgct tatacctttc ctcctaataa tgttcatctg 13260
tcacacaaac taaaataaat aaaatgggag caataaataa aatgggagct catatattta 13320
caccatttac actgtctatt attcaccatg ccaattatta cttcataatt ttaaaattat 13380
gtcattttta aaaattgctt aatgatggaa aggattatta taagttaaaa gtataacata 13440
gataaactaa ccacaaaaca aatcaatata aactaactta ctctcccatc taatttttat 13500
ttaaatttct ttacacttct cttccatttc tatttctaca acattattta acatttttat 13560
tgtatttttc ttactttcta actctattca tttcaaaaat caatatatgt ttatcaccac 13620
ctctctaaaa aaaactttac aatcattggt ccagaaaagt taaatcacga gatggtcatt 13680
ttagcattaa aacaacgatt cttgtatcac tatttttcag catgtagtcc attctcttca 13740
aacaaagaca gcggctatat aatcgttgtg ttatattcag tctaaaacaa ggcgcctact 13800
accggtaatt cccgggatta gcggccgcta gtctgtgcgc acttgtatcc tgcaggttag 13860
gccggccatt agcagatatt tggtgtctaa atgtttattt tgtgatatgt tcatgtttga 13920
aatggtggtt tcgaaaccag ggacaacgtt gggatctgat agggtgtcaa agagtattat 13980
ggattgggac aatttcggtc atgagttgca aattcaagta tatcgttcga ttatgaaaat 14040
tttcgaagaa tatcccattt gagagagtct ttacctcatt aatgttttta gattatgaaa 14100
ttttatcata gttcatcgta gtctttttgg tgtaaaggct gtaaaaagaa attgttcact 14160
tttgttttcg tttatgtgaa ggctgtaaaa gattgtaaaa gactattttg gtgttttgga 14220
taaaatgata gtttttatag attcttttgc ttttagaaga aatacatttg aaatttttc 14280

catgttgagt ataaaatacc gaaatcgatt gaagatcata gaaatatttt aactgaaaac 14340
aaatttataa ctgattcaat tctctccatt tttataccta tttaaccgta atcgattcta 14400
atagatgatc gattttttat ataatcctaa ttaaccaacg gcatgtattg gataattaac 14460
cgatcaactc tcacccctaa tagaatcagt attttccttc gacgttaatt gatcctacac 14520
tatgtaggtc atatccatcg ttttaatttt tggccaccat tcaattctgt cttgccttta 14580
gggatgtgaa tatgaacggc caaggtaaga gaataaaaat aatccaaatt aaagcaagag 14640
aggccaagta agataatcca aatgtacact tgtcattgcc aaaattagta aaatactcgg 14700
catattgtat tcccacacat tattaaaata ccgtatatgt attggctgca tttgcatgaa 14760
taatactacg tgtaagccca aaagaaccca cgtgtagccc atgcaaagtt aacactcacg 14820
accccattcc tcagtctcca ctatataaac ccaccatccc caatctcacc aaacccacca 14880
cacaactcac aactcactct cacaccttaa agaaccaatc accaccaaaa aaccgcgcca 14940
ccatgcttgt tcttttcgga aacttctacg tgaagcagta ctctcaaaag aacggaaagc 15000
ctgagaacgg tgctactcct gaaaacggtg caaagcctca accttgtgag aacggaactg 15060
ttgagaagag ggagaacgat accgctaatg ttagacctac tagaccagct ggacctcctc 15120
ctgctactta ctacgattct ctcgctgttt ctggacaggg aaaagagaga cttttcacca 15180
ccgacgaagt tagaaggcac atcctcccta ctgacggatg gcttacttgt cacgagggag 15240
tttacgacgt tactgacttc cttgcaaaac accctggtgg aggtgttatc actcttggac 15300
tcggaagaga ttgcactatc ctcatcgagt cttaccaccc tgctggtaga cctgataagg 15360
tgatggaaaa gtaccgtatc ggaactcttc aagaccctaa gactttctac gcttggggag 15420
agtctgattt ctaccctgag cttaagagaa gggctcttgc tagacttaaa gaggctggac 15480
aagctagaag aggtggactt ggagttaagg ctctccttgt tcttactctc ttcttcgtgt 15540
cttggtatat gtgggttgca cacaagtctt tcttgtgggc tgctgtttgg ggattcgctg 15600
gatcacatgt gggactttct atccagcacg acggaaacca cggtgctttc tctagaaaca 15660
ccctcgttaa cagacttgct ggatggggaa tggatcttat cggagcttct tctactgttt 15720
gggagtacca gcacgttatc ggacaccacc agtacactaa cctcgtttct gataccctttt 15780
tcagccttcc tgagaacgat cctgatgtgt tctcttctta ccctctcatg agaatgcacc 15840
ctgatactgc ttggcaacct caccacagat tccagcacct tttcgctttc cctttgttcg 15900
ctctcatgac catctctaag gttctcacct ctgatttcgc tgtttgcctc tctatgaaga 15960
agggatctat cgattgctct agcagacttg ttcctcttga gggacaactt cttttctggg 16020
gtgctaaact tgctaacttc ctcctccaaa tcgttcttcc ttgttacctt cacggaactg 16080
ctatgggact tgctctttc tctgttgctc accttgtttc tggtgagtac cttgctatct 16140
gcttcatcat caaccacatc tctgagtctt gtgagttcat gaacacctca ttccaaactg 16200
ctgctagaag aactgagatg cttcaagctg ctcatcaagc tgctgaggct aagaaggtta 16260
agcctactcc tcctcctaac gattgggctg ttactcaagt tcagtgctgt gttaactggc 16320
gttctggtgg agttcttgct aaccaccttt ctggtggact taaccaccag atcgagcacc 16380
acctcttccc ttctatctct cacgctaact accctactat cgctcctgtt gtgaaagaag 16440
tgtgcgagga atacggactt ccttacaaga actacgtgac cttctgggat gctgtttgtg 16500
gaatggttca gcaccttaga cttatgggtg ctcctcctgt tcctactaac ggtgacaaaa 16560
aaagttgatg attaattaat aattgattgc tgctttaatg agatatgcga gacgcctatg 16620
atcgcatgat atttgctttc aattctgttg tgcacgttgt aaaaaacctg agcatgtgta 16680
gctcagatcc ttaccgccgg tttcggttca ttctaatgaa tatatcaccc gttactatcg 16740
tatttttatg aataatattc tccgttcaat ttactgattg tggcaaacac tgtacggacc 16800
gtggcctaat aggccggtac ccaactttat tatacatagt tgataattca ctggccggat 16860
gtaccgaatt cgcggccgca agcttgtaca ctagtacgcg tcaattggcg atcgcagtac 16920
ttaatcagtg atcagtaact aaattcagta cattaaagac gtccgcaatg tgttattaag 16980
ttgtctaagc gtcaatttgt ttacaccaca atatatcctg ccaccagcca gccaacagct 17040
ccccgaccgg cagctcggca caaaatcact gatcatctaa aaaggtgatg tgtatttgag 17100
taaaacagct tgcgtcatgc ggtcgctgcg tatatgatgc gatgagtaaa taaacaaata 17160
cgcaagggga acgcatgaag gttatcgctg tacttaacca gaaaggcggg tcaggcaaga 17220
cgaccatcgc aacccatcta gcccgcgccc tgcaactcgc cggggccgat gttctgttag 17280
tcgattccga tccccagggc agtgcccgcg attgggcggc cgtgcgggaa gatcaaccgc 17340
taaccgttgt cggcatcgac cgcccgacga ttgaccgcga cgtgaaggcc atcggccggc 17400
gcgacttcgt agtgatcgac ggagcgcccc aggcggcgga cttggctgtg tccgcgatca 17460
aggcagccga cttcgtgctg attccggtgc agccaagccc ttacgacatt tgggccaccg 17520
ccgacctggt ggagctggtt aagcagcgca ttgaggtcac ggatggaagg ctacaagcgg 17580
cctttgtcgt gtcgcgggcg atcaaaggca cgcgcatcgg cggtgaggtt gccgaggcgc 17640
tggccgggta cgagctgccc attcttgagt cccgtatcac gcagcgcgtg agctacccag 17700
gcactgccgc cgccggcaca accgttcttg aatcagaacc cgagggcgac gctgcccgcg 17760
aggtccaggc gctggccgct gaaattaaat caaaactcat ttgagttaat gaggtaaaga 17820
gaaaatgagc aaaagcacaa acacgctaag tgccggccgt ccgagcgcac gcagcagcaa 17880
ggctgcaacg ttggccagcc tggcagacac gccagccatg aagcgggtca actttcagtt 17940
gccggcggag gatcacacca agctgaagat gtacgcggta cgccaaggca agaccattac 18000
cgagctgcta tctgaataca tcgcgcagct accagagtaa atgagcaaat gaataaatga 18060
gtagatgaat tttagcggct aaaggaggcg gcatggaaaa tcaagaacaa ccaggcaccg 18120
acgccgtgga atgccccatg tgtggaggaa cgggcggttg gccaggcgta agcggctggg 18180
ttgtctgccg gccctgcaat ggcactggaa cccccaagcc cgaggaatcg gcgtgagcgg 18240
tcgcaaacca tccggcccgg tacaaatcgg cgcggcgctg ggtgatgacc tggtggagaa 18300
gttgaaggcc gcgcaggccg cccagcggca acgcatcgag gcagaagcac gccccggtga 18360

atcgtggcaa ggggccgctg atcgaatccg caaagaatcc cggcaaccgc cggcagccgg 18420
tgcgccgtcg attaggaagc cgcccaaggg cgacgagcaa ccagattttt tcgttccgat 18480
gctctatgac gtgggcaccc gcgatagtcg cagcatcatg gacgtggccg ttttccgtct 18540
gtcgaagcgt gaccgacgag ctggcgaggt gatccgctac gagcttccag acgggcacgt 18600
agaggtttcc gcaggccccg ccggcatggc cagtgtgtgg gattacgacc tggtactgat 18660
ggcggtttcc catctaaccg aatccatgaa ccgataccgg gaagggaagg gagacaagcc 18720
cggccgcgtg ttccgtccac acgttgcgga cgtactcaag ttctgccggc gagccgatgg 18780
cggaaagcag aaagacgacc tggtagaaac ctgcattcgg ttaaacacca cgcacgttgc 18840
catgcagcgt accaagaagg ccaagaacgg ccgcctggtg acggtatccg agggtgaagc 18900
cttgattagc cgctacaaga tcgtaaagag cgaaaccggg cggccggagt acatcgagat 18960
cgagcttgct gattggatgt accgcgagat cacagaaggc aagaacccgg acgtgctgac 19020
ggttcacccc gattactttt tgatcgaccc cggcatcggc cgttttctct accgcctggc 19080
acgccgcgcc gcaggcaagg cagaagccag atggttgttc aagacgatct acgaacgcag 19140
tggcagcgcc ggagagttca agaagttctg tttcaccgtg cgcaagctga tcgggtcaaa 19200
tgacctgccg gagtacgatt tgaaggagga ggcggggcag gctggcccga tcctagtcat 19260
gcgctaccgc aacctgatcg agggcgaagc atccgccggt tcctaatgta cggagcagat 19320
gctagggcaa attgccctag caggggaaaa aggtcgaaaa ggtctctttc ctgtggatag 19380
cacgtacatt gggaacccaa agccgtacat tgggaaccgg aacccgtaca ttgggaaccc 19440
aaagccgtac attgggaacc ggtcacacat gtaagtgact gatataaaag agaaaaaagg 19500
cgatttttcc gcctaaaact ctttaaaact tattaaaact cttaaaaccc gcctggcctg 19560
tgcataactg tctggccagc gcacagccga agagctgcaa aaagcgccta cccttcggtc 19620
gctgcgctcc ctacgccccg ccgcttcgcg tcggcctatc gcggcctatg cggtgtgaaa 19680
taccgcacag atgcgtaagg agaaaatacc gcatcaggcg ctcttccgct tcctcgctca 19740
ctgactcgct gcgctcggtc gttcggctgc ggcgagcggt atcagctcac tcaaaggcgg 19800
taatacggtt atccacagaa tcaggggata acgcaggaaa gaacatgtga gcaaaaggcc 19860
agcaaaaggc caggaaccgt aaaaaggccg cgttgctggc gtttttccat aggctccgcc 19920
cccctgacga gcatcacaaa aatcgacgct caagtcagag gtggcgaaac ccgacaggac 19980
tataaagata ccaggcgttt ccccctggaa gctccctcgt gcgctctcct gttccgaccc 20040
tgccgcttac cggatacctg tccgcctttc tcccttcggg aagcgtggcg ctttctcata 20100
gctcacgctg taggtatctc agttcggtgt aggtcgttcg ctccaagctg ggctgtgtgc 20160
acgaaccccc cgttcagccc gaccgctgcg ccttatccgg taactatcgt cttgagtcca 20220
acccggtaag acacgactta tcgccactgg cagcagccac tggtaacagg attagcagag 20280
cgaggtatgt aggcggtgct acagagttct tgaagtggtg gcctaactac ggctacacta 20340
gaaggacagt atttggtatc tgcgctctgc tgaagccagt taccttcgga aaaagagttg 20400
gtagctcttg atccggcaaa caaaccaccg ctggtagcgg tggttttttt gtttgcaagc 20460
agcagattac gcgcagaaaa aaaggatctc aagaagatcc tttgatcttt tctacggggt 20520
ccttcaactc atcgatagtt tggctgtgag caattatgtg cttagtgcat ctaacgcttg 20580
agttaagccg cgccgcgaag cggcgtcggc ttgaacgaat ttctagctag acattatttg 20640
ccaacgacct tcgtgatctc gcccttgaca tagtggacaa attcttcgag ctggtcggcc 20700
cgggacgcga gacggtcttc ttcttggccc agataggctt ggcgcgcttc gaggatcacg 20760
ggctggtatt gcgccggaag gcgctccatc gcccagtcgg cggcgacatc cttcggcgcg 20820
atcttgccgg taaccgccga gtaccaaatc cggctcagcg taaggaccac attgcgctca 20880
tcgcccgccc aatccggcgg ggagttccac agggtcagcg tctcgttcag tgcttcgaac 20940
agatcctgtt ccggcaccgg gtcgaaaagt tcctcggccg cggggccgac gagggccacg 21000
ctatgctccc gggccttggt gagcaggatc gccagatcaa tgtcgatggt ggccggttca 21060
aagatacccg ccagaatatc attacgctgc cattcgccga actggagttc gcgtttggcc 21120
ggatagcgcc aggggatgat gtcatcgtgc accacaatcg tcacctcaac cgcgcgcagg 21180
atttcgctct cgccggggga ggcggacgtt tccagaaggt cgttgataag cgcgcggcgc 21240
gtggtctcgt cgagacggac ggtaacggtg acaagcaggt cgatgtccga atggggctta 21300
aggccgccgt caacggcgct accatacaga tgcacggcga ggagggtcgg ttcgaggtgg 21360
cgctcgatga cacccacgac ttccgacagc tgggtggaca cctcggcgat gaccgcttca 21420
cccatgatgt ttaactttgt tttagggcga ctgccctgct gcgtaacatc gttgctgctc 21480
cataacatca aacatcgacc cacggcgtaa cgcgcttgct gcttggatgc ccgaggcata 21540
gactgtaccc caaaaaaaca gtcataacaa gccatgaaaa ccgccactgc gttccatgaa 21600
tattcaaaca aacacataca gcgcgactta tcatggata 21639

<210> 10
<211> 15517
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 10
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180

```
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc    240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa    300
gcttggccac taaggccaat ttaaatctac taggccggcc aaagtaggcg cctactaccg    360
gtaattcccg ggattagcgg ccgctagtct gtgcgcactt gtatcctgca ggtcaatcgt    420
ttaaacactg tacggaccgt ggcctaatag gccggtaccc aagtttgtac aaaaaagcag    480
gctccatgat tacgccaagc ttggccacta aggccaattt aaatctacta ggccggccaa    540
agctttacaa cgctacacaa aacttataac cgtaatcacc attcattaac ttaactacta    600
tcacatgcat tcatgaattg aaacgagaag gatgtaaata gttgggaagt tatctccacg    660
ttgaagagat cgttagcgag agctgaaaga ccgagggagg agacgccgtc aacacggaca    720
gagtcgtcga ccctcacatg aagtaggagg aatctccgtg aggagccaga gagacgtctt    780
tggtcttcgg tttcgatcct tgatctgacg gagaagacga gagaagtgcg actggactcc    840
gtgaggacca acagagtcgt cctcggtttc gatcgtcggt attggtggag aaggcggagg    900
aatctccgtg acgagccaga gagatgtcgt cggtcttcgg tttcgatcct tgatctgacg    960
gagaagacga gagaagtgcg acgagactcc gtgaggacca acagagttgt cctcggtttc   1020
gatcgtcggt ttcggcggag aaggcggagg aatctccgtg aggagccaga gagacgtcgt   1080
tggtcttcgg tttcgatcct tgatctgttg gagaagacga gacaagtggg acgagactca   1140
acgacggagt cagagacgtc gtcggtcttc ggtttcggcc gagaaggcgg agtcggtctt   1200
cggtttcggc cgagaaggcg gaggagacgt cttcgatttg ggtctctcct cttgacgaag   1260
aaaacaaaga acacgagaaa taatgagaaa gagaacaaaa gaaaaaaaaa taaaaataaa   1320
aataaaattt ggtcctctta tgtggtgaca cgtggtttga aacccaccaa ataatcgatc   1380
acaaaaaacc taagttaagg atcggtaata acctttctaa ttaatttga tttatattaa   1440
atcactcttt ttatttataa accccactaa attatgcgat attgattgtc taagtacaaa   1500
aattctctcg aattcaatac acatgtttca tatatttagc cctgttcatt taatattact   1560
agcgcatttt taatttaaaa ttttgtaaac ttttttggtc aaagaacatt tttttaatta   1620
gagacagaaa tctagactct ttatttggaa taatagtaat aaagatatat taggcaatga   1680
gtttatgatg ttatgtttat atagtttatt tcattttaaa ttgaaaagca ttattttttat   1740
cgaaatgaat ctagtataca atcaatattt atgtttttttc atcagatact ttcctatttt   1800
ttggcacctt tcatcggact actgatttat ttcaatgtgt atgcatgcat gagcatgagt   1860
atacacatgt cttttaaaat gcatgtaaag cgtaacggac cacaaaagag gatccataca   1920
aatacatctc atcgcttcct ctactattct ccgacacaca cactgagcat ggtgcttaaa   1980
cactctggtg agttctagta cttctgctat gatcgatctc attaccattt cttaaatttc   2040
tctccctaaa tattccgagt tcttgatttt tgataacttc aggttttctc tttttgataa   2100
atctggtctt tccatttttt tttttttgtg gttaatttag tttcctatgt tcttcgattg   2160
tattatgcat gatctgtgtt tggattctgt tagattatgt attggtgaat atgtatgtgt   2220
ttttgcatgt ctggttttgg tcttaaaaat gttcaaatct gatgatttga ttgaagcttt   2280
tttagtgttg gtttgattct tctcaaaact actgttaatt tactatcatg ttttccaact   2340
ttgattcatg atgacacttt tgttctgctt tgttataaaa ttttggttgg tttgattttg   2400
taattatagt gtaattttgt taggaatgaa catgttttaa tactctgttt tcgatttgtc   2460
acacattcga attattaatc gataatttaa ctgaaaattc atggttctag atcttgttgt   2520
catcagatta tttgtttcga taattcatca aatatgtagt ccttttgctg atttgcgact   2580
gtttcatttt ttctcaaaat tgttttttgt taagtttatc taacagttat cgttgtcaaa   2640
agtctctttc attttgcaaa atcttctttt tttttttgtt tgtaactttg ttttttaagc   2700
tacacattta gtctgtaaaa tagcatcgag gaacagttgt cttagtagac ttgcatgttc   2760
ttgtaacttc tatttgtttc agtttgttga tgactgcttt gattttgtag gtcaaaccgc   2820
gccatgtctg ctagcggagc tttgttgcct gctatagctt tcgctgctta cgcttacgct   2880
acctacgctt atgctttcga gtggagccac gctaacggaa tcgataacgt ggatgctaga   2940
gagtggattg gagctttgtc tttgagactc cctgcaattg caaccacaat gtacctcttg   3000
ttctgccttg tgggacctag attgatggct aagagggagg cttttgatcc taagggattt   3060
atgctcgctt acaacgctta ccaaaccgct ttcaacgttg tggtgctcgg aatgttcgct   3120
agagagatct ctggattggg acaacctgtt tggggatcta ctatgccttg gagcgatagg   3180
aagtccttca agatttttgtt gggagtgtgg ctccactaca acaataagta cctcgagttg   3240
ttggatactg tgttcatggt ggctaggaaa aagaccaagc agctctcttt cttgcacgtg   3300
taccaccacg ctttgttgat ttgggcttgg tggcttgttt gtcacctcat ggctaccaac   3360
gattgcatcg atgcttattt cggagctgct tgcaactctt tcatccacat cgtgatgtac   3420
tcctactacc tcatgtctgc tttgggaatt aggtgccctt ggaagagata tatcacccag   3480
gctcagatgt tgcaattcgt gatcgtgttc gctcacgctg ttttcgtgct cagacaaaag   3540
cactgccctg ttactttgcc ttgggcacaa atgttcgtga tgacaaatat gttggtgctc   3600
ttcggaaact tctacctcaa ggcttactct aacaagtcta ggggagatgg agcttcttct   3660
gttaagcctg ctgagactac tagagcacct tctgtgagaa gaaccaggtc aaggaagatc   3720
gattgatagt taattaacta agtttgatgt atctgagtgc caacgtttac tttgtctttc   3780
ctttctttta ttggttatga ttagatgttt actatgttct ctcttttttcg ttataaataa   3840
agaagttcaa ttcttctata gtttcaaacg cgattttaag cgtttctatt taggtttaca   3900
tgatttcttt tacaaaatca tctttaaaat acagtatatt tttagttttc ataaaatatt   3960
taaagaaatg aaagtttata aacattcact cctattctct aattaaggat ttgtaaaaca   4020
aaaatttgt aagcatatcg atttatgcgt tttgtcttaa ttagctcact aaataataaa   4080
taatagctta tgttgtggga ctgtttaatt acctaactta gaactaaaat caactctttg   4140
tgggcgccta ctaccggtaa ttcccgggat tagcggccgc tagtctgtgc gcacttgtat   4200
cctgcaggtc aatcgtttaa acactgtacg gaccgtggcc taataggccg gtaccaccca   4260
```

gctttcttgt acaaagtggc catgattacg ccaagcttgg ccactaaggc caatttaaat 4320
ctactaggcc ggcctactat agaaaatgtg ttatatcgac atgaccagac aaaggggcaa 4380
cagttaacaa aacaattaat tctttcattt gagattaagg aaggtaaggt actaaaaaga 4440
ttaaaaaaaa tgagcttatc tctttgtttc tgtaataata atataagtgt gataaacttt 4500
taatataata attgtaatta ggttttctac agatgagcac cactcagaga caagataaga 4560
agaaaacaat tttgttaaac atgattatag aaacttttag ttaagtcttg aagtatcaat 4620
ataacaaaaa aaagtacaca cgactatgac aataaaccca ctaccgtcag gttatcattt 4680
cgatgaaatg ttttgatatc attaaatata acagtcacaa aaaatcatct aattataaca 4740
atataactta tacatatatt taactaaaaa cttagagttt ttgtaatgat tctaattgat 4800
gattagagtt tatagaaata caattaaata aaaaatataa ttttaaaaaa acatagtaaa 4860
gtcaatgaga tcctctctga cctcagtgat catttagtca tgtatgtaca acaatcattg 4920
ttcatcacat gactgtaaaa taaataagga taaacttggg aatatatata atatattgta 4980
ttaaataaaa aagggaaata caaatatcaa ttttagattc ccgagttgac acaactcacc 5040
atgcacgctg ccacctcagc tcccagctct cgtcacatgt ctcatgtcag ttaggtcttt 5100
ggtttttagt ctttgacaca actcgccatg catgttgcca cgtgagctcg ttcctcttcc 5160
catgatctca ccactgggca tgcatgctgc cacctcagct ggcacctctt ctctatatgt 5220
ccctagaggc catgcacagt gccacctcag cactcctctc agaacccata cgtacctgcc 5280
aatcggcttc tctccataaa tatctattta aattataact aattatttca tatacttaat 5340
tgatgacgtg gatgcattgc catcgttgtt taataattgt taattacgac atgataaata 5400
aaatgaaagt aaaaagtacg aaagattttc catttgttgt tgtataaata gagaagtgag 5460
tgatgcataa tgcatgaatg catgaccgcg ccaccatgac tgttggatac gatgaggaga 5520
tcccattcga gcaagttagg gctcataaca agccagatga tgcttggtgt gctattcatg 5580
gacacgtgta cgatgttacc aagttcgctt ctgttcatcc aggaggagat attatcttgc 5640
tcgctgctgg aaaggaagct actgtgctct acgagaccta ccatgttaga ggagtgtctg 5700
atgctgtgct cagaaagtac agaatcggaa agttgccaga tggacaagga ggagctaacg 5760
agaaggagaa gagaaccttg tctggattgt cctctgcttc ttactacacc tggaactccg 5820
atttctacag agtgatgagg gagagagttg tggctagatt gaaggagaga ggaaaggcta 5880
gaagaggagg atacgagttg tggatcaagg ctttcttgct ccttgttgga ttctggtcct 5940
ctctttactg gatgtgcacc ctcgatccat ctttcggagc tatcttggct gctatgtctt 6000
tgggagtgtt cgctgctttt gttggaacct gcatccaaca tgatggaaac catggagcgt 6060
tcgctcaatc tagatgggtt aacaaggtgg caggatggac tttggatatg atcggagctt 6120
ctggaatgac ttgggagttc caacatgtgt tgggacatca cccatacact aacttgatcg 6180
aggaggagaa cggattgcaa aaggtgtccg gaaagaagat ggataccaag ttggctgatc 6240
aagagtctga tccagatgtg ttctccacct acccaatgat gagattgcat ccatggcatc 6300
agaagagatg gtatcacagg ttccagcata tctacggacc attcatcttc ggattcatga 6360
ccatcaacaa ggtggtgact caagatgttg gagtggtgtt gagaaagagg ctcttccaaa 6420
tcgatgctga gtgcagatat gcttccccaa tgtacgttgc taggttctgg atcatgaagg 6480
ctttgaccgt gttgtacatg gttgctctcc catgttatat gcaaggacca tggcatggat 6540
tgaagctctt cgctatcgct catttcactt gcggagaggt tttggctacc atgttcatcg 6600
tgaaccacat tatcgaggga gtgtcttacg cttctaagga tgctgttaag ggaactatgg 6660
ctccaccaaa gactatgcat ggagtgaccc caatgaacaa cactagaaag gaggttgagg 6720
ctgaggcttc taagtctgga gctgtggtta agtctgtgcc attggatgat tgggctgctg 6780
ttcaatgcca aacctctgtg aactggtctg ttggatcttg gttctggaac catttctctg 6840
gaggactcaa ccatcaaatc gagcatcatc tcttcccagg attgtctcac gagacctact 6900
accacatcca agatgtggtt caatctacct gtgctgagta cggagttcca taccaacatg 6960
agccatcttt gtggactgct tactggaaga tgctcgaaca tttgagacaa ttgggaaacg 7020
aggagactca cgagtcttgg caaagagctg cttgattaat taactaagac tcccaaaacc 7080
accttccctg tgacagttaa accctgctta tacctttcct cctaataatg ttcatctgtc 7140
acacaaacta aaataaataa aatgggagca ataaataaaa tgggagctca tatatttaca 7200
ccatttacac tgtctattat tcaccatgcc aattattact tcataatttt aaaattatgt 7260
catttttaaa aattgcttaa tgatggaaag gattattata agttaaaagt ataacataga 7320
taaactaacc acaaaacaaa tcaatataaa ctaacttact ctcccatcta atttttattt 7380
aaatttcttt acacttctct tccatttcta tttctacaac attatttaac atttttattg 7440
tatttttctt actttctaac tctattcatt tcaaaaatca atatatgttt atcaccacct 7500
ctctaaaaaa aactttacaa tcattggtcc agaaaagtta aatcacgaga tggtcatttt 7560
agcattaaaa caacgattct tgtatcacta tttttcagca tgtagtccat tctcttcaaa 7620
caaagacagc ggctatataa tcgttgtgtt atattcagtc taaaacaagg cgcctactac 7680
cggtaattcc cgggattagc ggccgctagt ctgtgcgcac ttgtatcctg caggttaggc 7740
cggccattag cagatatttg gtgtctaaat gtttatttg tgatatgttc atgtttgaaa 7800
tggtggtttc gaaaccaggg acaacgttgg gatctgatag ggtgtcaaag agtattatgg 7860
attgggacaa tttcggtcat gagttgcaaa ttcaagtata tcgttcgatt atgaaaattt 7920
tcgaagaata tcccatttga gagagtcttt acctcattaa tgtttttaga ttatgaaatt 7980
ttatcatagt tcatcgtagt ctttttggtg taaaggctgt aaaaagaaat tgttcacttt 8040
tgttttcgtt tatgtgaagg ctgtaaaaga ttgtaaaaga ctattttggt gttttggata 8100
aaatgatagt ttttatagat tcttttgctt ttagaagaaa tacatttgaa attttttcca 8160
tgttgagtat aaaataccga aatcgattga agatcataga aatattttaa ctgaaaacaa 8220
atttataact gattcaattc tctccatttt tatacctatt taaccgtaat cgattctaat 8280
agatgatcga ttttttatat aatcctaatt aaccaacggc atgtattgga taattaaccg 8340

atcaactctc acccctaata gaatcagtat tttccttcga cgttaattga tcctacacta 8400
tgtaggtcat atccatcgtt ttaatttttg gccaccattc aattctgtct tgcctttagg 8460
gatgtgaata tgaacggcca aggtaagaga ataaaaataa tccaaattaa agcaagagag 8520
gccaagtaag ataatccaaa tgtacacttg tcattgccaa aattagtaaa atactcggca 8580
tattgtattc ccacacatta ttaaaatacc gtatatgtat tggctgcatt tgcatgaata 8640
atactacgtg taagcccaaa agaacccacg tgtagcccat gcaaagttaa cactcacgac 8700
cccattcctc agtctccact atataaaccc accatcccca atctcaccaa acccaccaca 8760
caactcacaa ctcactctca caccttaaag aaccaatcac caccaaaaaa ccgcgccacc 8820
atgcttgttc ttttcggaaa cttctacgtg aagcagtact ctcaaaagaa cggaaagcct 8880
gagaacggtg ctactcctga aaacggtgca aagcctcaac cttgtgagaa cggaactgtt 8940
gagaagaggg agaacgatac cgctaatgtt agacctacta gaccagctgg acctcctcct 9000
gctacttact acgattctct cgctgtttct ggacagggaa aagagagact tttcaccacc 9060
gacgaagtta gaaggcacat cctccctact gacggatggc ttacttgtca cgagggagtt 9120
tacgacgtta ctgacttcct tgcaaaacac cctggtggag gtgttatcac tcttggactc 9180
ggaagagatt gcactatcct catcgagtct taccaccctg ctggtagacc tgataaggtg 9240
atggaaaagt accgtatcgg aactcttcaa gaccctaaga ctttctacgc ttggggagag 9300
tctgatttct accctgagct taagagaagg gctcttgcta gacttaaaga ggctggacaa 9360
gctagaagag gtggacttgg agttaaggct ctccttgttc ttactctctt cttcgtgtct 9420
tggtatatgt gggttgcaca caagtctttc ttgtgggctg ctgtttgggg attcgctgga 9480
tcacatgtgg gactttctat ccagcacgac ggaaaccacg gtgctttctc tagaaacacc 9540
ctcgttaaca gacttgctgg atggggaatg gatcttatcg gagcttcttc tactgtttgg 9600
gagtaccagc acgttatcgg acaccaccag tacactaacc tcgtttctga tacccttttc 9660
agccttcctg agaacgatcc tgatgtgttc tcttcttacc ctctcatgag aatgcaccct 9720
gatactgctt ggcaacctca ccacagattc cagcaccttt tcgctttccc tttgttcgct 9780
ctcatgacca tctctaaggt tctcacctct gatttcgctg tttgcctctc tatgaagaag 9840
ggatctatcg attgctctag cagacttgtt cctcttgagg gacaacttct tttctggggt 9900
gctaaacttg ctaacttcct cctccaaatc gttcttcctt gttaccttca cggaactgct 9960
atgggacttg ctcttttctc tgttgctcac cttgtttctg gtgagtacct tgctatctgc 10020
ttcatcatca accacatctc tgagtcttgt gagttcatga acacctcatt ccaaactgct 10080
gctagaagaa ctgagatgct tcaagctgct catcaagctg ctgaggctaa gaaggttaag 10140
cctactcctc ctcctaacga ttgggctgtt actcaagttc agtgctgtgt taactggcgt 10200
tctggtggag ttcttgctaa ccacctttct ggtggactta accaccagat cgagcaccac 10260
ctcttccctt ctatctctca cgctaactac cctactatcg ctcctgttgt gaaagaagtg 10320
tgcgaggaat acggacttcc ttacaagaac tacgtgacct tctgggatgc tgtttgtgga 10380
atggttcagc accttagact tatgggtgct cctcctgttc ctactaacgg tgacaaaaaa 10440
agttgatgat taattaataa ttgattgctg ctttaatgag atatgcgaga cgcctatgat 10500
cgcatgatat ttgctttcaa ttctgttgtg cacgttgtaa aaaacctgag catgtgtagc 10560
tcagatcctt accgccggtt tcggttcatt ctaatgaata tatcacccgt tactatcgta 10620
tttttatgaa taatattctc cgttcaattt actgattgtg gcaaacactg tacggaccgt 10680
ggcctaatag gccggtaccc aactttatta tacatagttg ataattcact ggccggatgt 10740
accgaattcg cggccgcaag cttgtacact agtacgcgtc aattggcgat cgcagtactt 10800
aatcagtgat cagtaactaa attcagtaca ttaaagacgt ccgcaatgtg ttattaagtt 10860
gtctaagcgt caatttgttt acaccacaat atatcctgcc accagccagc caacagctcc 10920
ccgaccggca gctcggcaca aaatcactga tcatctaaaa aggtgatgtg tatttgagta 10980
aaacagcttg cgtcatgcgg tcgctgcgta tatgatgcga tgagtaaata aacaaatacg 11040
caaggggaac gcatgaaggt tatcgctgta cttaaccaga aaggcgggtc aggcaagacg 11100
accatcgcaa cccatctagc ccgcgccctg caactcgccg gggccgatgt tctgttagtc 11160
gattccgatc cccagggcag tgcccgcgat tgggcggccg tgcgggaaga tcaaccgcta 11220
accgttgtcg gcatcgaccg cccgacgatt gaccgcgacg tgaaggccat cggccggcgc 11280
gacttcgtag tgatcgacgg agcgccccag gcggcggact tggctgtgtc cgcgatcaag 11340
gcagccgact tcgtgctgat tccggtgcag ccaagccctt acgacatttg ggccaccgcc 11400
gacctggtgg agctggttaa gcagcgcatt gaggtcacgg atggaaggct acaagcggcc 11460
tttgtcgtgt cgcgggcgat caaaggcacg cgcatcggcg gtgaggttgc cgaggcgctg 11520
gccgggtacg agctgcccat tcttgagtcc cgtatcacgc agcgcgtgag ctacccaggc 11580
actgccgccg ccggcacaac cgttcttgaa tcagaacccg agggcgacgc tgcccgcgag 11640
gtccaggcgc tggccgctga aattaaatca aaactcattt gagttaatga ggtaaagaga 11700
aaatgagcaa aagcacaaac acgctaagtg ccggccgtcc gagcgcacgc agcagcaagg 11760
ctgcaacgtt ggccagcctg gcagacacgc cagccatgaa gcgggtcaac tttcagttgc 11820
cggcggagga tcacaccaag ctgaagatgt acgcggtacg ccaaggcaag accattaccg 11880
agctgctatc tgaatacatc gcgcagctac cagagtaaat gagcaaatga ataaatgagt 11940
agatgaattt tagcggctaa aggaggcggc atggaaaatc aagaacaacc aggcaccgac 12000
gccgtggaat gccccatgtg tggaggaacg ggcggttggc caggcgtaag cggctgggtt 12060
gtctgccggc cctgcaatgg cactggaacc cccaagcccg aggaatcggc gtgagcggtc 12120
gcaaaccatc cggcccggta caaatcggcg cggcgctggg tgatgacctg gtggagaagt 12180
tgaaggccgc gcaggccgcc cagcggcaac gcatcgaggc agaagcacgc cccggtgaat 12240
cgtggcaagg ggccgctgat cgaatccgca aagaatcccg gcaaccgccg gcagccggtg 12300
cgccgtcgat taggaagccg cccaagggcg acgagcaacc agattttttc gttccgatgc 12360
tctatgacgt gggcacccgc gatagtcgca gcatcatgga cgtggccgtt ttccgtctgt 12420

cgaagcgtga ccgacgagct ggcgaggtga tccgctacga gcttccagac gggcacgtag 12480
aggtttccgc aggccccgcc ggcatggcca gtgtgtggga ttacgacctg gtactgatgg 12540
cggtttccca tctaaccgaa tccatgaacc gataccggga agggaaggga gacaagcccg 12600
gccgcgtgtt ccgtccacac gttgcggacg tactcaagtt ctgccggcga gccgatggcg 12660
gaaagcagaa agacgacctg gtagaaacct gcattcggtt aaacaccacg cacgttgcca 12720
tgcagcgtac caagaaggcc aagaacggcc gcctggtgac ggtatccgag ggtgaagcct 12780
tgattagccg ctacaagatc gtaaagagcg aaaccgggcg gccggagtac atcgagatcg 12840
agcttgctga ttggatgtac cgcgagatca cagaaggcaa gaacccggac gtgctgacgg 12900
ttcaccccga ttactttttg atcgaccccg gcatcggccg ttttctctac cgcctggcac 12960
gccgcgccgc aggcaaggca gaagccagat ggttgttcaa gacgatctac gaacgcagtg 13020
gcagcgccgg agagttcaag aagttctgtt tcaccgtgcg caagctgatc gggtcaaatg 13080
acctgccgga gtacgatttg aaggaggagg cggggcaggc tggcccgatc ctagtcatgc 13140
gctaccgcaa cctgatcgag ggcgaagcat ccgccggttc ctaatgtacg gagcagatgc 13200
tagggcaaat tgccctagca ggggaaaaag gtcgaaaagg tctctttcct gtggatagca 13260
cgtacattgg gaacccaaag ccgtacattg ggaaccggaa cccgtacatt gggaacccaa 13320
agccgtacat tgggaaccgg tcacacatgt aagtgactga tataaaagag aaaaaaggcg 13380
atttttccgc ctaaaactct ttaaaactta ttaaaactct taaaacccgc ctggcctgtg 13440
cataactgtc tggccagcgc acagccgaag agctgcaaaa agcgcctacc cttcggtcgc 13500
tgcgctccct acgccccgcc gcttcgcgtc ggcctatcgc ggcctatgcg gtgtgaaata 13560
ccgcacagat gcgtaaggag aaaataccgc atcaggcgct cttccgcttc ctcgctcact 13620
gactcgctgc gctcggtcgt tcggctgcgg cgagcggtat cagctcactc aaaggcggta 13680
atacggttat ccacagaatc aggggataac gcaggaaaga acatgtgagc aaaaggccag 13740
caaaaggcca ggaaccgtaa aaaggccgcg ttgctggcgt ttttccatag gctccgcccc 13800
cctgacgagc atcacaaaaa tcgacgctca agtcagaggt ggcgaaaccc gacaggacta 13860
taaagatacc aggcgtttcc ccctggaagc tccctcgtgc gctctcctgt tccgaccctg 13920
ccgcttaccg gatacctgtc cgcctttctc ccttcgggaa gcgtggcgct ttctcatagc 13980
tcacgctgta ggtatctcag ttcggtgtag gtcgttcgct ccaagctggg ctgtgtgcac 14040
gaaccccccg ttcagcccga ccgctgcgcc ttatccggta actatcgtct tgagtccaac 14100
ccggtaagac acgacttatc gccactggca gcagccactg gtaacaggat tagcagagcg 14160
aggtatgtag gcggtgctac agagttcttg aagtggtggc ctaactacgg ctacactaga 14220
aggacagtat ttggtatctg cgctctgctg aagccagtta ccttcggaaa aagagttggt 14280
agctcttgat ccggcaaaca aaccaccgct ggtagcggtg gtttttttgt ttgcaagcag 14340
cagattacgc gcagaaaaaa aggatctcaa gaagatcctt tgatcttttc tacggggtcc 14400
ttcaactcat cgatagtttg gctgtgagca attatgtgct tagtgcatct aacgcttgag 14460
ttaagccgcg ccgcgaagcg gcgtcggctt gaacgaattt ctagctagac attatttgcc 14520
aacgaccttc gtgatctcgc ccttgacata gtggacaaat tcttcgagct ggtcggcccg 14580
ggacgcgaga cggtcttctt cttggcccag ataggcttgg cgcgcttcga ggatcacggg 14640
ctggtattgc gccggaaggc gctccatcgc ccagtcggcg gcgacatcct tcggcgcgat 14700
cttgccggta accgccgagt accaaatccg gctcagcgta aggaccacat tgcgctcatc 14760
gcccgcccaa tccggcgggg agttccacag ggtcagcgtc tcgttcagtg cttcgaacag 14820
atcctgttcc ggcaccgggt cgaaaagttc ctcggccgcg gggccgacga gggccacgct 14880
atgctcccgg gccttggtga gcaggatcgc cagatcaatg tcgatggtgg ccggttcaaa 14940
gatacccgcc agaatatcat tacgctgcca ttcgccgaac tggagttcgc gtttggccgg 15000
atagcgccag ggatgatgt catcgtgcac cacaatcgtc acctcaaccg cgcgcaggat 15060
ttcgctctcg ccgggggagg cggacgtttc cagaaggtcg ttgataagcg cgcggcgcgt 15120
ggtctcgtcg agacggacgg taacggtgac aagcaggtcg atgtccgaat ggggcttaag 15180
gccgccgtca acggcgctac catacagatg cacggcgagg agggtcggtt cgaggtggcg 15240
ctcgatgaca cccacgactt ccgacagctg ggtggacacc tcggcgatga ccgcttcacc 15300
catgatgttt aactttgttt tagggcgact gccctgctgc gtaacatcgt tgctgctcca 15360
taacatcaaa catcgaccca cggcgtaacg cgcttgctgc ttggatgccc gaggcataga 15420
ctgtacccca aaaaaacagt cataacaagc catgaaaacc gccactgcgt tccatgaata 15480
ttcaaacaaa cacatacagc gcgacttatc atggata 15517

<210> 11
<211> 15229
<212> DNA
<213> Artificial Sequence

<220>
<223> plasmid

<400> 11
ttgacataca aatggacgaa cggataaacc ttttcacgcc cttttaaata tccgattatt 60
ctaataaacg ctcttttctc ttaggtttac ccgccaatat atcctgtcaa acactgatag 120
tttaaactga aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt 180
aatctagagg cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc 240
ggtacatcga ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa 300
gcttggccac taaggccaat ttaaatctac taggccggcc aaagtaggcg cctactaccg 360

```
gtaattcccg ggattagcgg ccgctagtct gtgcgcactt gtatcctgca ggtcaatcgt    420
ttaaacactg tacggaccgt ggcctaatag gccggtaccc aagtttgtac aaaaaagcag    480
gctccatgat tacgccaagc ttggccacta aggccaattt aaatctacta ggccggccaa    540
agctttacaa cgctacacaa aacttataac cgtaatcacc attcattaac ttaactacta    600
tcacatgcat tcatgaattg aaacgagaag gatgtaaata gttgggaagt tatctccacg    660
ttgaagagat cgttagcgag agctgaaaga ccgagggagg agacgccgtc aacacggaca    720
gagtcgtcga ccctcacatg aagtaggagg aatctccgtg aggagccaga gagacgtctt    780
tggtcttcgg tttcgatcct tgatctgacg gagaagacga gagaagtgcg actggactcc    840
gtgaggacca acagagtcgt cctcggtttc gatcgtcggt attggtggag aaggcggagg    900
aatctccgtg acgagccaga gagatgtcgt cggtcttcgg tttcgatcct tgatctgacg    960
gagaagacga gagaagtgcg acgagactcc gtgaggacca acagagttgt cctcggtttc   1020
gatcgtcggt ttcggcggag aaggcggagg aatctccgtg aggagccaga gagacgtcgt   1080
tggtcttcgg tttcgatcct tgatctgttg gagaagacga gacaagtggg acgagactca   1140
acgacggagt cagagacgtc gtcggtcttc ggtttcggcc gagaaggcgg agtcggtctt   1200
cggtttcggc cgagaaggcg gaggagacgt cttcgatttg ggtctctcct cttgacgaag   1260
aaaacaaaga acacgagaaa taatgagaaa gagaacaaaa gaaaaaaaaa taaaaataaa   1320
aataaaattt ggtcctctta tgtggtgaca cgtggtttga aacccaccaa ataatcgatc   1380
acaaaaaacc taagttaagg atcggtaata acctttctaa ttaattttga tttatattaa   1440
atcactcttt ttatttataa accccactaa attatgcgat attgattgtc taagtacaaa   1500
aattctctcg aattcaatac acatgtttca tatatttagc cctgttcatt taatattact   1560
agcgcatttt taatttaaaa ttttgtaaac ttttttggtc aaagaacatt tttttaatta   1620
gagacagaaa tctagactct ttatttggaa taatagtaat aaagatatat taggcaatga   1680
gtttatgatg ttatgtttat atagtttatt tcattttaaa ttgaaaagca ttatttttat   1740
cgaaatgaat ctagtataca atcaatattt atgtttttc atcagatact ttcctatttt   1800
ttggcacctt tcatcggact actgatttat ttcaatgtgt atgcatgcat gagcatgagt   1860
atacacatgt cttttaaaat gcatgtaaag cgtaacggac cacaaaagag gatccataca   1920
aatacatctc atcgcttcct ctactattct ccgacacaca cactgagcat ggtgcttaaa   1980
cactctggtg agttctagta cttctgctat gatcgatctc attaccattt cttaaatttc   2040
tctccctaaa tattccgagt tcttgatttt tgataacttc aggttttctc tttttgataa   2100
atctggtctt tccatttttt tttttttgtg gttaatttag tttcctatgt tcttcgattg   2160
tattatgcat gatctgtgtt tggattctgt tagattatgt attggtgaat atgtatgtgt   2220
ttttgcatgt ctggttttgg tcttaaaaat gttcaaatct gatgatttga ttgaagcttt   2280
tttagtgttg gtttgattct tctcaaaact actgttaatt tactatcatg ttttccaact   2340
ttgattcatg atgacacttt tgttctgctt tgttataaaa ttttggttgg tttgattttg   2400
taattatagt gtaattttgt taggaatgaa catgttttaa tactctgttt tcgatttgtc   2460
acacattcga attattaatc gataatttaa ctgaaaattc atggttctag atcttgttgt   2520
catcagatta tttgtttcga taattcatca aatatgtagt ccttttgctg atttgcgact   2580
gtttcatttt ttctcaaaat tgttttttgt taagtttatc taacagttat cgttgtcaaa   2640
agtctctttc attttgcaaa atcttctttt tttttttgtt tgtaactttg ttttttaagc   2700
tacacattta gtctgtaaaa tagcatcgag gaacagttgt cttagtagac ttgcatgttc   2760
ttgtaacttc tatttgtttc agtttgttga tgactgcttt gattttgtag gtcaaaccgc   2820
gccatgtctg ctagcggagc tttgttgcct gctatagctt tcgctgctta cgcttacgct   2880
acctacgctt atgctttcga gtggagccac gctaacggaa tcgataacgt ggatgctaga   2940
gagtggattg gagctttgtc tttgagactc cctgcaattg caaccacaat gtacctcttg   3000
ttctgccttg tgggacctag attgatggct aagagggagg cttttgatcc taagggattt   3060
atgctcgctt acaacgctta ccaaaccgct ttcaacgttg tggtgctcgg aatgttcgct   3120
agagagatct ctggattggg acaacctgtt tggggatcta ctatgccttg gagcgatagg   3180
aagtccttca agatttgtt gggagtgtgg ctccactaca acaataagta cctcgagttg   3240
ttggatactg tgttcatggt ggctaggaaa aagaccaagc agctctcttt cttgcacgtg   3300
taccaccacg ctttgttgat ttgggcttgg tggcttgttt gtcacctcat ggctaccaac   3360
gattgcatcg atgcttattt cggagctgct tgcaactctt tcatccacat cgtgatgtac   3420
tcctactacc tcatgtctgc tttgggaatt aggtgccctt ggaagagata tatcacccag   3480
gctcagatgt tgcaattcgt gatcgtgttc gctcacgctg ttttcgtgct cagacaaaag   3540
cactgccctg ttactttgcc ttgggcacaa atgttcgtga tgacaaatat gttggtgctc   3600
ttcggaaact tctacctcaa ggcttactct aacaagtcta ggggagatgg agcttcttct   3660
gttaagcctg ctgagactac tagagcacct tctgtgagaa gaaccaggtc aaggaagatc   3720
gattgatagt taattaacta agtttgatgt atctgagtgc caacgtttac tttgtctttc   3780
ctttctttta ttggttatga ttagatgttt actatgttct ctctttttcg ttataaataa   3840
agaagttcaa ttcttctata gtttcaaacg cgattttaag cgtttctatt taggtttaca   3900
tgatttcttt tacaaaatca tctttaaaat acagtatatt tttagttttc ataaaatatt   3960
taaagaaatg aaagtttata aacattcact cctattctct aattaaggat ttgtaaaaca   4020
aaaattttgt aagcatatcg atttatgcgt tttgtcttaa ttagctcact aaataataaa   4080
taatagctta tgttgtggga ctgtttaatt acctaactta gaactaaaat caactctttg   4140
tgggcgccta ctaccggtaa ttcccgggat tagcggccgc tagtctgtgc gcacttgtat   4200
cctgcaggtc aatcgtttaa acactgtacg gaccgtggcc taataggccg gtaccaccca   4260
gctttcttgt acaaagtggc catgattacg ccaagcttgg ccactaaggc caatttaaat   4320
ctactaggcc ggcctactat agaaaatgtg ttatatcgac atgaccagac aaaggggcaa   4380
cagttaacaa aacaattaat tctttcattt gagattaagg aaggtaaggt actaaaaaga   4440
```

ttaaaaaaaa tgagcttatc tctttgtttc tgtaataata atataagtgt gataaacttt 4500
taatataata attgtaatta ggttttctac agatgagcac cactcagaga caagataaga 4560
agaaaacaat tttgttaaac atgattatag aaacttttag ttaagtcttg aagtatcaat 4620
ataacaaaaa aaagtacaca cgactatgac aataaaccca ctaccgtcag gttatcattt 4680
cgatgaaatg ttttgatatc attaaatata acagtcacaa aaaatcatct aattataaca 4740
atataactta tacatatatt taactaaaaa cttagagttt ttgtaatgat tctaattgat 4800
gattagagtt tatagaaata caattaaata aaaaatataa ttttaaaaaa acatagtaaa 4860
gtcaatgaga tcctctctga cctcagtgat catttagtca tgtatgtaca acaatcattg 4920
ttcatcacat gactgtaaaa taaataagga taaacttggg aatatatata atatattgta 4980
ttaaataaaa aagggaaata caaatatcaa ttttagattc ccgagttgac acaactcacc 5040
atgcacgctg ccacctcagc tcccagctct cgtcacatgt ctcatgtcag ttaggtcttt 5100
ggtttttagt ctttgacaca actcgccatg catgttgcca cgtgagctcg ttcctcttcc 5160
catgatctca ccactgggca tgcatgctgc cacctcagct ggcacctctt ctctatatgt 5220
ccctagaggc catgcacagt gccacctcag cactcctctc agaacccata cgtacctgcc 5280
aatcggcttc tctccataaa tatctattta aattataact aattatttca tatacttaat 5340
tgatgacgtg gatgcattgc catcgttgtt taataattgt taattacgac atgataaata 5400
aaatgaaagt aaaaagtacg aaagattttc catttgttgt tgtataaata gagaagtgag 5460
tgatgcataa tgcatgaatg catgaccgcg ccaccatgac tgttggatac gatgaggaga 5520
tcccattcga gcaagttagg gctcataaca agccagatga tgcttggtgt gctattcatg 5580
gacacgtgta cgatgttacc aagttcgctt ctgttcatcc aggaggagat attatcttgc 5640
tcgctgctgg aaaggaagct actgtgctct acgagaccta ccatgttaga ggagtgtctg 5700
atgctgtgct cagaaagtac agaatcggaa agttgccaga tggacaagga ggagctaacg 5760
agaaggagaa gagaaccttg tctggattgt cctctgcttc ttactacacc tggaactccg 5820
atttctacag agtgatgagg gagagagttg tggctagatt gaaggagaga ggaaaggcta 5880
gaagaggagg atacgagttg tggatcaagg ctttcttgct ccttgttgga ttctggtcct 5940
ctctttactg gatgtgcacc ctcgatccat ctttcggagc tatcttggct gctatgtctt 6000
tgggagtgtt cgctgctttt gttggaacct gcatccaaca tgatggaaac catggagctt 6060
tcgctcaatc tagatgggtt aacaaggtgg caggatggac tttggatatg atcggagctt 6120
ctggaatgac ttgggagttc caacatgtgt tgggacatca cccatacact aacttgatcg 6180
aggaggagaa cggattgcaa aaggtgtccg gaaagaagat ggataccaag ttggctgatc 6240
aagagtctga tccagatgtg ttctccacct acccaatgat gagattgcat ccatggcatc 6300
agaagagatg gtatcacagg ttccagcata tctacggacc attcatcttc ggattcatga 6360
ccatcaacaa ggtggtgact caagatgttg gagtggtgtt gagaaagagg ctcttccaaa 6420
tcgatgctga gtgcagatat gcttccccaa tgtacgttgc taggttctgg atcatgaagg 6480
ctttgaccgt gttgtacatg gttgctctcc catgttatat gcaaggacca tggcatggat 6540
tgaagctctt cgctatcgct catttcactt gcggagaggt tttggctacc atgttcatcg 6600
tgaaccacat tatcgaggga gtgtcttacg cttctaagga tgctgttaag ggaactatgg 6660
ctccaccaaa gactatgcat ggagtgaccc caatgaacaa cactagaaag gaggttgagg 6720
ctgaggcttc taagtctgga gctgtggtta agtctgtgcc attggatgat tgggctgctg 6780
ttcaatgcca aacctctgtg aactggtctg ttggatcttg gttctggaac catttctctg 6840
gaggactcaa ccatcaaatc gagcatcatc tcttcccagg attgtctcac gagacctact 6900
accacatcca agatgtggtt caatctacct gtgctgagta cggagttcca taccaacatg 6960
agccatcttt gtggactgct tactggaaga tgctcgaaca tttgagacaa ttgggaaacg 7020
aggagactca cgagtcttgg caaagagctg cttgattaat taactaagac tcccaaaacc 7080
accttccctg tgacagttaa accctgctta tacctttcct cctaataatg ttcatctgtc 7140
acacaaacta aaataaataa aatgggagca ataaataaaa tgggagctca tatatttaca 7200
ccatttacac tgtctattat tcaccatgcc aattattact tcataatttt aaaattatgt 7260
catttttaaa aattgcttaa tgatggaaag gattattata agttaaaagt ataacataga 7320
taaactaacc acaaaacaaa tcaatataaa ctaacttact ctcccatcta atttttattt 7380
aaatttcttt acacttctct tccatttcta tttctacaac attatttaac atttttattg 7440
tatttttctt actttctaac tctattcatt tcaaaaatca atatatgttt atcaccacct 7500
ctctaaaaaa aactttacaa tcattggtcc agaaaagtta aatcacgaga tggtcatttt 7560
agcattaaaa caacgattct tgtatcacta tttttcagca tgtagtccat tctcttcaaa 7620
caaagacagc ggctatataa tcgttgtgtt atattcagtc taaaacaagg cgcctactac 7680
cggtaattcc cgggattagc ggccgctagt ctgtgcgcac ttgtatcctg caggttaggc 7740
cggccattag cagatatttg gtgtctaaat gtttatttg tgatatgttc atgtttgaaa 7800
tggtggtttc gaaaccaggg acaacgttgg gatctgatag ggtgtcaaag agtattatgg 7860
attgggacaa tttcggtcat gagttgcaaa ttcaagtata tcgttcgatt atgaaaattt 7920
tcgaagaata tcccatttga gagagtcttt acctcattaa tgtttttaga ttatgaaatt 7980
ttatcatagt tcatcgtagt ctttttggtg taaaggctgt aaaaagaaat tgttcacttt 8040
tgttttcgtt tatgtgaagg ctgtaaaaga ttgtaaaaga ctattttggt gttttggata 8100
aaatgatagt ttttatagat tcttttgctt ttagaagaaa tacatttgaa attttttcca 8160
tgttgagtat aaaataccga aatcgattga agatcataga aatattttaa ctgaaaacaa 8220
atttataact gattcaattc tctccatttt tatacctatt taaccgtaat cgattctaat 8280
agatgatcga ttttttatat aatcctaatt aaccaacggc atgtattgga taattaaccg 8340
atcaactctc acccctaata gaatcagtat tttccttcga cgttaattga tcctacacta 8400
tgtaggtcat atccatcgtt ttaatttttg gccaccattc aattctgtct tgcctttagg 8460
gatgtgaata tgaacggcca aggtaagaga ataaaaataa tccaaattaa agcaagagag 8520

gccaagtaag ataatccaaa tgtacacttg tcattgccaa aattagtaaa atactcggca 8580
tattgtattc ccacacatta ttaaaatacc gtatatgtat tggctgcatt tgcatgaata 8640
atactacgtg taagcccaaa agaacccacg tgtagcccat gcaaagttaa cactcacgac 8700
cccattcctc agtctccact atataaaccc accatcccca atctcaccaa acccaccaca 8760
caactcacaa ctcactctca caccttaaag aaccaatcac caccaaaaaa ccgcgccacc 8820
atgccaccta gtgctgctag tgaaggtggt gttgctgaac ttagagctgc tgaagttgct 8880
agctacacta gaaaggctgt tgacgaaaga cctgacctca ctatagttgg tgacgctgtt 8940
tacgacgcta aggcttttag ggacgagcac cctggtggtg ctcacttcgt tagccttttc 9000
ggaggtaggg acgctactga ggcttttatg gaatatcacc gtagagcttg gcctaaggct 9060
aggatgtcta agttcttcgt tggttcactt gacgctagcg agaagcctac tcaagctgat 9120
tcagcttacc ttagactttg cgctgaggtt aacgctcttt tgcctaaggg tagcggagga 9180
ttcgctcctc ctagctactg gcttaaggct gctgctcttg ttgttgctgc tgttagtata 9240
gagggttata tgctccttag ggtaagacc cttttgctta gcgttttcct tggactcgtg 9300
ttcgcttgga taggacttaa tattcagcac gacgctaatc acggtgctct tagtagacac 9360
tcagtgatta actactgcct cggttacgct caggattgga taggtggtaa tatggtgctt 9420
tggcttcaag agcacgttgt gatgcaccac ctccacacta acgacgttga cgctgatcct 9480
gatcaaaagg ctcacggtgt tcttagactt aagcctactg acggttggat gccttggcac 9540
gcacttcaac aactctatat ccttcctggt gaggctatgt acgcttttaa gcttcttttc 9600
ttggacgccc ttgagcttct tgcttggagg tgggagggtg agaagattag ccctcttgct 9660
agagctttgt tcgctcctgc tgttgcttgt aagcttggat tctgggctag attcgttgct 9720
ctccctctct ggcttcaacc tactgttcac actgctttgt gtatctgtgc tactgtgtgt 9780
actggtagct tctacctcgc cttcttcttc tttatctctc acaacttcga cggtgttggt 9840
agcgttggac ctaagggatc acttcctaga tcagctactt tcgttcaacg tcaggttgag 9900
actagctcta acgttggtgg ttactggctt ggagttctta acggtggact taactttcag 9960
atagagcacc acttgttccc taggcttcac cactcttact acgctcaaat agctcctgtg 10020
gttaggactc acatagagaa gctcggtttt aagtaccgtc acttccctac cgttggatct 10080
aaccttagct caatgcttca gcatatgggt aagatgggaa ctagacctgg tgctgagaag 10140
ggtggtaagg ctgagtagtg attaattaat aattgattgc tgctttaatg agatatgcga 10200
gacgcctatg atcgcatgat atttgctttc aattctgttg tgcacgttgt aaaaaacctg 10260
agcatgtgta gctcagatcc ttaccgccgg tttcggttca ttctaatgaa tatatcaccc 10320
gttactatcg tatttttatg aataatattc tccgttcaat ttactgattg tggcaaacac 10380
tgtacggacc gtggcctaat aggccggtac ccaactttat tatacatagt tgataattca 10440
ctggccggat gtaccgaatt cgcggccgca agcttgtaca ctagtacgcg tcaattggcg 10500
atcgcagtac ttaatcagtg atcagtaact aaattcagta cattaaagac gtccgcaatg 10560
tgttattaag ttgtctaagc gtcaatttgt ttacaccaca atatatcctg ccaccagcca 10620
gccaacagct ccccgaccgg cagctcggca caaaatcact gatcatctaa aaaggtgatg 10680
tgtatttgag taaaacagct tgcgtcatgc ggtcgctgcg tatatgatgc gatgagtaaa 10740
taaacaaata cgcaagggga acgcatgaag gttatcgctg tacttaacca gaaaggcggg 10800
tcaggcaaga cgaccatcgc aacccatcta gcccgcgccc tgcaactcgc cggggccgat 10860
gttctgttag tcgattccga tccccagggc agtgcccgcg attgggcggc cgtgcgggaa 10920
gatcaaccgc taaccgttgt cggcatcgac cgcccgacga ttgaccgcga cgtgaaggcc 10980
atcggccggc gcgacttcgt agtgatcgac ggagcgcccc aggcggcgga cttggctgtg 11040
tccgcgatca aggcagccga cttcgtgctg attccggtgc agccaagccc ttacgacatt 11100
tgggccaccg ccgacctggt ggagctggtt aagcagcgca ttgaggtcac ggatggaagg 11160
ctacaagcgg cctttgtcgt gtcgcgggcg atcaaaggca cgcgcatcgg cggtgaggtt 11220
gccgaggcgc tggccgggta cgagctgccc attcttgagt cccgtatcac gcagcgcgtg 11280
agctacccag gcactgccgc cgccggcaca accgttcttg aatcagaacc cgagggcgac 11340
gctgcccgcg aggtccaggc gctggccgct gaaattaaat caaaactcat ttgagttaat 11400
gaggtaaaga gaaaatgagc aaaagcacaa acacgctaag tgccggccgt ccgagcgcac 11460
gcagcagcaa ggctgcaacg ttggccagcc tggcagacac gccagccatg aagcgggtca 11520
actttcagtt gccggcggag gatcacacca agctgaagat gtacgcggta cgccaaggca 11580
agaccattac cgagctgcta tctgaataca tcgcgcagct accagagtaa atgagcaaat 11640
gaataaatga gtagatgaat tttagcggct aaaggaggcg gcatggaaaa tcaagaacaa 11700
ccaggcaccg acgccgtgga atgccccatg tgtggaggaa cgggcggttg gccaggcgta 11760
agcggctggg ttgtctgccg gccctgcaat ggcactggaa cccccaagcc cgaggaatcg 11820
gcgtgagcgg tcgcaaacca tccggcccgg tacaaatcgg cgcggcgctg ggtgatgacc 11880
tggtggagaa gttgaaggcc gcgcaggccg cccagcggca acgcatcgag gcagaagcac 11940
gccccggtga atcgtggcaa ggggccgctg atcgaatccg caaagaatcc cggcaaccgc 12000
cggcagccgg tgcgccgtcg attaggaagc cgcccaaggg cgacgagcaa ccagattttt 12060
tcgttccgat gctctatgac gtgggcaccc gcgatagtcg cagcatcatg gacgtggccg 12120
ttttccgtct gtcgaagcgt gaccgacgag ctggcgaggt gatccgctac gagcttccag 12180
acgggcacgt agaggtttcc gcaggccccg ccggcatggc cagtgtgtgg gattacgacc 12240
tggtactgat ggcggtttcc catctaaccg aatccatgaa ccgataccgg gaagggaagg 12300
gagacaagcc cggccgcgtg ttccgtccac acgttgcgga cgtactcaag ttctgccggc 12360
gagccgatgg cggaaagcag aaagacgacc tggtagaaac ctgcattcgg ttaaacacca 12420
cgcacgttgc catgcagcgt accaagaagg ccaagaacgg ccgcctggtg acggtatccg 12480
agggtgaagc cttgattagc cgctacaaga tcgtaaagag cgaaaccggg cggccggagt 12540
acatcgagat cgagcttgct gattggatgt accgcgagat cacagaaggc aagaacccgg 12600

acgtgctgac ggttcacccc gattactttt tgatcgaccc cggcatcggc cgttttctct 12660
accgcctggc acgccgcgcc gcaggcaagg cagaagccag atggttgttc aagacgatct 12720
acgaacgcag tggcagcgcc ggagagttca agaagttctg tttcaccgtg cgcaagctga 12780
tcgggtcaaa tgacctgccg gagtacgatt tgaaggagga ggcggggcag gctggcccga 12840
tcctagtcat gcgctaccgc aacctgatcg agggcgaagc atccgccggt tcctaatgta 12900
cggagcagat gctagggcaa attgccctag caggggaaaa aggtcgaaaa ggtctctttc 12960
ctgtggatag cacgtacatt gggaacccaa agccgtacat tgggaaccgg aacccgtaca 13020
ttgggaaccc aaagccgtac attgggaacc ggtcacacat gtaagtgact gatataaaag 13080
agaaaaaagg cgatttttcc gcctaaaact ctttaaaact tattaaaact cttaaaaccc 13140
gcctggcctg tgcataactg tctggccagc gcacagccga agagctgcaa aaagcgccta 13200
cccttcggtc gctgcgctcc ctacgccccg ccgcttcgcg tcggcctatc gcggcctatg 13260
cggtgtgaaa taccgcacag atgcgtaagg agaaaatacc gcatcaggcg ctcttccgct 13320
tcctcgctca ctgactcgct gcgctcggtc gttcggctgc ggcgagcggt atcagctcac 13380
tcaaaggcgg taatacggtt atccacagaa tcaggggata acgcaggaaa gaacatgtga 13440
gcaaaaggcc agcaaaaggc caggaaccgt aaaaaggccg cgttgctggc gtttttccat 13500
aggctccgcc cccctgacga gcatcacaaa aatcgacgct caagtcagag gtggcgaaac 13560
ccgacaggac tataaagata ccaggcgttt ccccctggaa gctccctcgt gcgctctcct 13620
gttccgaccc tgccgcttac cggatacctg tccgcctttc tcccttcggg aagcgtggcg 13680
ctttctcata gctcacgctg taggtatctc agttcggtgt aggtcgttcg ctccaagctg 13740
ggctgtgtgc acgaaccccc cgttcagccc gaccgctgcg ccttatccgg taactatcgt 13800
cttgagtcca acccggtaag acacgactta tcgccactgg cagcagccac tggtaacagg 13860
attagcagag cgaggtatgt aggcggtgct acagagttct tgaagtggtg gcctaactac 13920
ggctacacta gaaggacagt atttggtatc tgcgctctgc tgaagccagt taccttcgga 13980
aaaagagttg gtagctcttg atccggcaaa caaaccaccg ctggtagcgg tggttttttt 14040
gtttgcaagc agcagattac gcgcagaaaa aaaggatctc aagaagatcc tttgatcttt 14100
tctacggggt ccttcaactc atcgatagtt tggctgtgag caattatgtg cttagtgcat 14160
ctaacgcttg agttaagccg cgccgcgaag cggcgtcggc ttgaacgaat ttctagctag 14220
acattatttg ccaacgacct tcgtgatctc gcccttgaca tagtggacaa attcttcgag 14280
ctggtcggcc cgggacgcga gacggtcttc ttcttggccc agataggctt ggcgcgcttc 14340
gaggatcacg ggctggtatt gcgccggaag gcgctccatc gcccagtcgg cggcgacatc 14400
cttcggcgcg atcttgccgg taaccgccga gtaccaaatc cggctcagcg taaggaccac 14460
attgcgctca tcgcccgccc aatccggcgg ggagttccac agggtcagcg tctcgttcag 14520
tgcttcgaac agatcctgtt ccggcaccgg gtcgaaaagt tcctcggccg cggggccgac 14580
gagggccacg ctatgctccc gggccttggt gagcaggatc gccagatcaa tgtcgatggt 14640
ggccggttca aagataccg ccagaatatc attacgctgc cattcgccga actggagttc 14700
gcgtttggcc ggatagcgcc aggggatgat gtcatcgtgc accacaatcg tcacctcaac 14760
cgcgcgcagg atttcgctct cgccgggga ggcggacgtt tccagaaggt cgttgataag 14820
cgcgcggcgc gtggtctcgt cgagacggac ggtaacggtg acaagcaggt cgatgtccga 14880
atggggctta aggccgccgt caacggcgct accatacaga tgcacggcga ggagggtcgg 14940
ttcgaggtgg cgctcgatga cacccacgac ttccgacagc tgggtggaca cctcggcgat 15000
gaccgcttca cccatgatgt ttaactttgt tttagggcga ctgccctgct gcgtaacatc 15060
gttgctgctc cataacatca aacatcgacc cacggcgtaa cgcgcttgct gcttggatgc 15120
ccgaggcata gactgtaccc caaaaaaaca gtcataacaa gccatgaaaa ccgccactgc 15180
gttccatgaa tattcaaaca aacacataca gcgcgactta tcatggata 15229

<210> 12
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 12
cgctcacttc ttcgttgctg gactctc 27

<210> 13
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 13
atcatctctc tcggagttc 19

<210> 14

<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 14
cgctgctcct atcatcccaa ctttcttca 29

<210> 15
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 15
tcgacctaga ggatccccgg cc 22

<210> 16
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 16
ctctgccagc gaccaaatcg aagc 24

<210> 17
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 17
ccttgtgtta gtttaatg 18

<210> 18
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 18
tgacaaacaa gccaccaagc ccaa 24

<210> 19
<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 19
tgcttcccca atgtacgttg ctaggttct 29

<210> 20
<211> 14
<212> DNA

<213> Artificial Sequence

<220>
<223> probe oligo

<400> 20
aaggcacatc ctcc 14

<210> 21
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 21
agcttctttt cttggacgcc cttgagc 27

<210> 22
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> probe oligo

<400> 22
ggattcgaca ttccatcggc tttga 25

<210> 23
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 23
ccgctgtggt tatctctttg c 21

<210> 24
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 24
cttgggaggc tatgtatgtt agaaga 26

<210> 25
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 25
gctttccctg agcttgttag ga 22

<210> 26
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 26
ggaggctaag gctgctgcta 20

<210> 27
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 27
gaccccctct ctctcgttgt c 21

<210> 28
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 28
gcaatcgttg gtagccatga 20

<210> 29
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 29
caaatcgatg ctgagtgcag at 22

<210> 30
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 30
tgacaagtaa gccatccgtc agt 23

<210> 31
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 31
ctggtgaggc tatgtacgct ttt 23

<210> 32
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 32
gatgaatatc ctcctgatgc taacc 25

<210> 33
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 33
tcttaagtcc caactggaga gaca 24

<210> 34
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 34
aaaccaagga gcgtcaagtc taga 24

<210> 35
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 35
tcaacaactc cgtacttagc gtacat 26

<210> 36
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 36
tgcatgtacg ttatatagta ggcttttg 28

<210> 37
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 37
gcagatgtag aagccatggt ttg 23

<210> 38
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 38

cgtgtaccac cacgctttgt 20

<210> 39
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 39
aacacggtca aagccttcat aatc 24

<210> 40
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 40
acttttcacc accgacgaag tt 22

<210> 41
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 41
cctcccacct ccaagcaa 18

<210> 42
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 42
cttgcatgat gatcaggaaa gc 22

<210> 43
<211> 114
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 43
ttaattcagc tagctagcct cagctgacgt tacgtaacgc taggtagcgt cacgtgacgt 60
tagctaacgc taggtagcgt cagctgagct tacgtaagcg cttagcagat attt 114

<210> 44
<211> 157
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 44
ttactgattg tctacgtagg ctcagctgag cttacctaag gctacgtagg ctcacgtgac 60

gttacgtaag gctacgtagc gtcacgtgag cttacctaac tctagctagc ctcacgtgac 120
cttagctaac actaggtagc gtcagctcga cggcccg 157

<210> 45
<211> 106
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 45
ggcggagtgg ggctacgtag cgtcacgtga cgttacctaa gcctaggtag cctcagctga 60
cgttacgtaa cgctaggtag gctcagctga cacgggcagg acatag 106

<210> 46
<211> 204
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 46
gaatgaaacc gatctacgta ggctcagctg agcttagcta agcctaccta gcctcacgtg 60
agattatgta aggctaggta gcgtcacgtg acgttaccta acactagcta gcgtcagctg 120
agcttagcta accctacgta gcctcacgtg agcttaccta acgctacgta gcctcacgtg 180
actaaggatg acctacccat tctt 204

<210> 47
<211> 127
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 47
gcggccgcta gctagcctca gctgacgtta cgtaacgcta ggtagcgtca cgtgacgtta 60
gctaacgcta ggtagcgtca gctgagctta cgtaagcgcc acgggcagga catagggact 120
actacaa 127

<210> 48
<211> 160
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 48
cgaatgaaac cgatctacgt aggctcagct gagcttacct aaggctacgt aggctcacgt 60
gacgttacgt aaggctacgt agcgtcacgt gagcttacct aactctagct agcctcacgt 120
gaccttagct aacactaggt agcgtcagct tagcagatat 160

<210> 49
<211> 235
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 49
ccgttcaatt tactgattgt ctacgtagcg tcacctgacg ttacgtaagg ctacctaggc 60
tcacgtgacg ttacgtaacg ctacgtagcg tcaggtgagg ttagctaacg ctagctagcc 120
tcacctgacg ttaggtaagg ctacgtagcg tcacctgaga ttagctaagc ctacctagac 180
tcacgtgacc ttaggtaacg ctacgtagcg tcaaagcttt acaacgctac acaaa 235

<210> 50
<211> 208
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 50
ttacctaact tagaactaaa atcaactctt tgtgacgcgt ctacctagag tcagctgagc 60
ttagctaacg ctagctagtg tcagctgacg ttacgtaagg ctaactagcg tcacgtgacc 120
ttacgtaacg ctacgtaggc tcagctgagc ttagctaacc ctagctagtg tcacgtgagc 180
ttacgctact atagaaaatg tgttatat 208

<210> 51
<211> 117
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 51
ttcagtctaa aacaactacg tagcgtcacg tgacgttacc taagcctagg tagcctcagc 60
tgacgttacg taacgctagg taggctcagc tgactgcagc aaatttacac attgcca 117

<210> 52
<211> 179
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 52
taattcggcg ttaattcagc tacgtaggct cagctgagct tacctaaggc tacgtaggct 60
cacgtgacgt tacgtaaggc tacgtagcgt cacgtgagct tacctaactc tagctagcct 120
cacgtgacct tagctaacac taggtagcgt cagcacagat gaatactagc tgttgttca 179

<210> 53
<211> 147
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 53
atcatgatgc ttctctgagc cgtgtttgct agctagcctc agctgacgtt acgtaacgct 60
aggtagcgtc acgtgacgtt agctaacgct aggtagcgtc agctgagctt acgtaagcgc 120
acagatgaat actagctgtt gttcaca 147

<210> 54
<211> 169
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 54
cttctctgag ccgtgtttgc tagctagcct cagctgacgt tacgtaacgc taggtagcgt 60
cacgtgacgt tagctaacgc taggtagcgt cagctgagct tacgtaagcg cttaattaaa 120
gtactgatat cggtaccaaa tcgaatccaa aaattacgga tatgaatat 169

<210> 55
<211> 363

<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 55
attacaacgg tatatatcct gccagtcagc atcatcacac caaaagttag gcccgaatag 60
tttgaaatta gaaagctcgc aattgaggtc tacaggccaa attcgctctt agccgtacaa 120
tattactcac cggtgcgatg ccccccatcg taggtgaagg tggaaattaa tggcgcgcct 180
gatcactgat tagtaactat tacgtaagcc tacgtagcgt cacgtgacgt tagctaacgc 240
tacgtagcct cagctgacgt tacgtaagcc tacgtagcgt cacgtgagct tagctaacgc 300
tacctaggct cagctgacgt tacgtaacgc tagctagcgt cactcctgca gcaaatttac 360
aca 363

<210> 56
<211> 780
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 56
gagatgaaac cggtgattat cagaaccttt tatggtcttt gtatgcatat ggtaaaaaaa 60
cttagtttgc aatttcctgt ttgttttggt aatttgagtt tcttttagtt gttgatctgc 120
ctgctttttg gtttacgtca gactactact gctgttgttg tttggtttcc tttctttcat 180
tttataaata aataatccgg ttcggtttac tccttgtgac tggctcagtt tggttattgc 240
gaaatgcgaa tggtaaattg agtaattgaa attcgttatt agggttctaa gctgttttaa 300
cagtcactgg gttaatatct ctcgaatctt gcatggaaaa tgctcttacc attggttttt 360
aattgaaatg tgctcatatg ggccgtggtt tccaaattaa ataaaactac gatgtcatcg 420
agaagtaaaa tcaactgtgt ccacattatc agttttgtgt atacgatgaa atagggtaat 480
tcaaaatcta gcttgatatg ccttttggtt cattttaacc ttctgtaaac attttttcag 540
attttgaaca agtaaatcca aaaaaaaaaa aaaaaatctc aactcaacac taaattattt 600
taatgtataa aagatgctta aaacatttgg cttaaaagaa agaagctaaa aacatagaga 660
actcttgtaa attgaagtat gaaaatatac tgaattgggt attatatgaa tttttctgat 720
ttaggattca catgatccaa aaaggaaatc cagaagcact aatcagacat tggaagtagg 780

<210> 57
<211> 343
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 57
acatacaaat ggacgaacgg ataaaccttt tcacgccctt ttaaatatcc gattattcta 60
ataaacgctc ttttctctta ggtttacccg ccaatatatc ctgtcaaaca ctgatagttt 120
aaactgaagg cgggaaacga caatctgatc actgattagt aactaaggcc tttaattaat 180
ctagaggcgc gccgggcccc ctgcagggag ctcggccggc caatttaaat tgatatcggt 240
acatcgatta cgccaagcta tcaactttgt atagaaaagt tgccatgatt acgccaagct 300
tggccactaa ggccaatttc gcgccctgca gcaaatttac aca 343

<210> 58
<211> 168
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 58
caatttactg attgtgtcga cgcgatcgcg tgcaaacact gtacggaccg tggcctaata 60
ggccggtacc caagtttgta caaaaaagca ggctccatga ttacgccaag cttggccact 120
aaggccaatt taaatctact aggccggcca tcgacggccc ggactgta 168

<210> 59

<211> 108
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 59
ggcggagtgg ggggcgccta ctaccggtaa ttcccgggat tagcggccgc tagtctgtgc 60
gcacttgtat cctgcaggtt aggccggcca cacgggcagg acataggg 108

<210> 60
<211> 209
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 60
aaaccgaatg aaaccgatgg cgcctaccgg tatcggtccg attgcggccg cttaaagggc 60
gaattcgttt aaacactgta cggaccgtgg cctaataggc cggtaccacc cagctttctt 120
gtacaaagtg gccatgatta cgccaagctt ggccactaag gccaatttaa atctactagg 180
ccggccataa ggatgaccta cccattctt 209

<210> 61
<211> 114
<212> DNA
<213> Artificial Sequence

<220>
<223> spacer sequence

<400> 61
ttaattcagg gccggccaaa gtaggcgcct actaccggta attcccggga ttagcggccg 60
ctagtctgtg cgcacttgta tcctgcaggt taggccggcc attagcagat attt 114

<210> 62
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 62
cggagtttgt gaaccctaag ga 22

<210> 63
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 63
tgacaagtaa gccatccgtc agt 23

<210> 64
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 64

ctggtgaggc tatgtacgct ttt 23

<210> 65
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 65
caaatcgatg ctgagtgcag at 22

<210> 66
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 66
caccacgctg ctccaaacag 20

<210> 67
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 67
tgggcttggt ggcttgtt 18

<210> 68
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 68
tggctggatc tggagatatg tg 22

<210> 69
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 69
ttctgcttcg ctttgtctct ttac 24

<210> 70
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 70
gaggctggat tcctcgctta 20

<210> 71
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 71
cacactacaa gctcaagaag gctact 26

<210> 72
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 72
cttgggaggc tatgtatgtt agaaga 26

<210> 73
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 73
atagcatcga ggaacagttg tcttag 26

<210> 74
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 74
atagcatcga ggaacagttg tcttag 26

<210> 75
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 75
gttcgagtga ttatgaggtt atttctgt 28

<210> 76
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 76
ttctcctctt gtgagttgag tgttaag 27

<210> 77
<211> 27

<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 77
ttctcctctt gtgagttgag tgttaag 27

<210> 78
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 78
ggcttcttta attttgagct cagatt 26

<210> 79
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 79
tgttctcggt ctcaacacac atg 23

<210> 80
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 80
cggttataag ttttgtgtag cgttgt 26

<210> 81
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 81
gaccccctct ctctcgttgt c 21

<210> 82
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 82
catccacaaa gaaaccgaca ttt 23

<210> 83
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 83
gacgctagtt agccttacgt aacgt 25

<210> 84
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 84
gacgctagtt agccttacgt aacgt 25

<210> 85
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 85
catttagaca ccaaatatct gctaatgg 28

<210> 86
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 86
gacaacatgc atcaatggcg 20

<210> 87
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 87
cttcaaacaa agacagcggc tatat 25

<210> 88
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 88
gcaggtttag gcatatatat acgagtgt 28

<210> 89
<211> 22
<212> DNA
<213> Artificial Sequence

<220>

<223> forward primer

<400> 89
cggagtttgt gaaccctaag ga 22

<210> 90
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 90
caccgccgtt agtcatctca 20

<210> 91
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 91
acttttcacc accgacgaag tt 22

<210> 92
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 92
cctcccacct ccaagcaa 18

<210> 93
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 93
aacacggtca aagccttcat g 21

<210> 94
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 94
aaagcaacga gtggcaaggt 20

<210> 95
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 95
tgcaagcagc tccgaaataa 20

<210> 96
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 96
ccatatcgtg cctcactttt tg 22

<210> 97
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 97
ccacaaggaa tatctccagg tgat 24

<210> 98
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 98
tggatcgttc acgttgaagt g 21

<210> 99
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 99
attggctcat cggactttct ca 22

<210> 100
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 100
aaaccaagga gcgtcaagtc taga 24

<210> 101
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 101
aaagctccgc tagcagacat g 21

<210> 102
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 102
ccaatcttat ccatagcagc gtta 24

<210> 103
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 103
cagcctcagg gttcaaaata gccat 25

<210> 104
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 104
catccaactc tccgtagaac ctct 24

<210> 105
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 105
atctcggtga gagttgggaa aa 22

<210> 106
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 106
gatctcctcg tcgtatccaa cag 23

<210> 107
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 107
ggcttcttta attttgagct cagatt 26

<210> 108

<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 108
cagcggctat ataatcgttg tgtt 24

<210> 109
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 109
gcagatgtag aagccatggt ttg 23

<210> 110
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 110
cacctttgag tttatcgatg aaaca 25

<210> 111
<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 111
cttagaacta aaatcaactc tttgtgcta 29

<210> 112
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 112
ctctgagccg tgtttgctac c 21

<210> 113
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 113
ccaaaatcca gtactaaaat ccagatc 27

<210> 114
<211> 20
<212> DNA

<213> Artificial Sequence

<220>
<223> reverse primer

<400> 114
ttaggccacg gtccgtacag 20

<210> 115
<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 115
aacatttaga caccaaatat ctgctaatg 29

<210> 116
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 116
tcctagctct ttgtctgaag catact 26

<210> 117
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 117
caccgccgtt agtcatctca 20

<210> 118
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 118
catgacaagc cagttcagca agtcatcg 28

<210> 119
<211> 14
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 119
aaggcacatc ctcc 14

<210> 120
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 120
agcttctttt cttggacgcc cttgagc 27

<210> 121
<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 121
tgcttcccca atgtacgttg ctaggttct 29

<210> 122
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 122
ttggagcacg atgtggattt ga 22

<210> 123
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 123
tcacctcatg gctaccaacg attgca 26

<210> 124
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 124
actccatgca caacaagcac cacgc 25

<210> 125
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 125
tgtgcgtggg tatcgcttac caagc 25

<210> 126
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 126
aggaacggat acaccgttat gccatgc 27

<210> 127
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 127
tgctttccac caagctttcc cagagc 26

<210> 128
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 128
atcatctctc tcggagttc 19

<210> 129
<211> 17
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 129
agacttgcat gttcttg 17

<210> 130
<211> 17
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 130
agacttgcat gttcttg 17

<210> 131
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 131
tttgatttat gagttaatgg tcg 23

<210> 132
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 132

tgtaataatg gttcactttc 20

<210> 133
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 133
tgtaataatg gttcactttc 20

<210> 134
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 134
acccatttta cccggtgtt 19

<210> 135
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 135
acccatttta cccggtgtt 19

<210> 136
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 136
tacaagtgcg cacagactag cggcc 25

<210> 137
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 137
ctctgccagc gaccaaatcg aagc 24

<210> 138
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 138
atcataaatc agggtttcg 19

<210> 139
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 139
acactagcta gcgttagc 18

<210> 140
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 140
acactagcta gcgttagc 18

<210> 141
<211> 17
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 141
ctaacctgca ggataca 17

<210> 142
<211> 17
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 142
ctactaccgg taattcc 17

<210> 143
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 143
atcgttgtgt tatattcagt cta 23

<210> 144
<211> 15
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 144
acgggcagga catag 15

<210> 145
<211> 28

<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 145
catgacaagc cagttcagca agtcatcg 28

<210> 146
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 146
cacactacaa gctcaagaag gctact 26

<210> 147
<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 147
cgttgtgtta tattcagtct aaaacaagg 29

<210> 148
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 148
tttggtttct ttgagcagga gat 23

<210> 149
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 149
ctaattaata gtccgatcaa gctgaac 27

<210> 150
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 150
tctcatcgtt gttttctccc tttt 24

<210> 151
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 151
ggcttcttta attttgagct cagatt 26

<210> 152
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 152
attggctcat cggactttct ca 22

<210> 153
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 153
cctattaggc cacggtccg 19

<210> 154
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 154
tgggaaaacg taagcctcct t 21

<210> 155
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 155
tgagagaagg gaactcgtaa gga 23

<210> 156
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> primer

<400> 156
aaaccaagga gcgtcaagtc taga 24

<210> 157
<211> 19
<212> DNA
<213> Artificial Sequence

<220>

<223> primer

<400> 157
ggcatggtag gcgcattta 19

<210> 158
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 158
tgctttccac caagctttcc cagagc 26

<210> 159
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 159
cagtgtttaa acgattgac 19

<210> 160
<211> 13
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 160
cgcgccttcc atg 13

<210> 161
<211> 16
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 161
cagcgtcttg agcagc 16

<210> 162
<211> 14
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 162
cgctgctgtt ccac 14

<210> 163
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 163
acccatttta cccggtgtt 19

<210> 164
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 164
aagacgtccg caatgtgtta ttaa 24

<210> 165
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 165
ggcgcgcctc tagattaatt aa 22

<210> 166
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 166
ggcgcgcctc tagattaatt aa 22

<210> 167
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 167
ggcgcgcctc tagattaatt aa 22

<210> 168
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 168
gcggacatct acatttttga attg 24

<210> 169
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 169
cactgagcat ggtgcttaaa cac 23

<210> 170
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 170
ctctttcttt ttctccatat tgaccat 27

<210> 171
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 171
caattaaccg cggacatcta ca 22

<210> 172
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 172
aattaaccgc ggacatctac attt 24

<210> 173
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 173
ctctttcttt ttctccatat tgaccat 27

<210> 174
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 174
ctctttcttt ttctccatat tgaccat 27

<210> 175
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 175
ctctttcttt ttctccatat tgaccat 27

<210> 176

<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 176
ccatattgac catcatactc attgc 25

<210> 177
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 177
gacctcaatt gcgagctttc taa 23

<210> 178
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 178
tgtacggcta agagcgaatt tg 22

<210> 179
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> forward primer

<400> 179
gcctacctag actcacgtga cctt 24

<210> 180
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 180
acacctgaaa gggaaaatcc aa 22

<210> 181
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 181
cacacacctc cccaatccat 20

<210> 182
<211> 20
<212> DNA

<213> Artificial Sequence

<220>
<223> reverse primer

<400> 182
gggatcggag aaatcatcga 20

<210> 183
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 183
caccaaaagc aaccaagaga ga 22

<210> 184
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 184
gctatttgac ttcttcatct gtgtgtct 28

<210> 185
<211> 29
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 185
agagcgagag agaggaagta ggtatataa 29

<210> 186
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 186
ttaacgaaat caaacaacga cgtt 24

<210> 187
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 187
gcaaaacaac aagagcaaga aatact 26

<210> 188
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 188
cgggcagtga gtagtctgag aa 22

<210> 189
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 189
tgaggcatga agaagcaaat tatt 24

<210> 190
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 190
gcagtgactc atcaaaacaa cttttt 26

<210> 191
<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 191
acatttttat tcctgtatac gcacacat 28

<210> 192
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 192
tggctgatag ggttctttca aatata 26

<210> 193
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 193
cctcaccagg aaggatatag agttg 25

<210> 194
<211> 17
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 194
cgtgccaagg catccaa 17

<210> 195
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> reverse primer

<400> 195
aatgagagaa gaaacgcaag cat 23

<210> 196
<211> 17
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 196
tctaagcgtc aatttgt 17

<210> 197
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 197
ttactaatca gtgatcagat tgt 23

<210> 198
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 198
ttactaatca gtgatcagat tgt 23

<210> 199
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 199
ttactaatca gtgatcagat tgt 23

<210> 200
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 200

tttctccata ttgaccatca ta 22

<210> 201
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 201
ctggtgagtt ctagtactt 19

<210> 202
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 202
atactcattg ctgatccat 19

<210> 203
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 203
attatccaaa agagctattc aacct 25

<210> 204
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 204
atactcattg ctgatccat 19

<210> 205
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 205
atactcattg ctgatccat 19

<210> 206
<211> 16
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 206
cggacatgaa gccatt 16

<210> 207
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 207
atactcattg ctgatccat 19

<210> 208
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 208
taaattatac ttgatcggtc atctg 25

<210> 209
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 209
ttcaaactat tcgggcctaa 20

<210> 210
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 210
cgagctttct aatttcaa 18

<210> 211
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> probe

<400> 211
tagcgtcaaa gctttaca 18

<210> 212
<211> 1100
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 212
atatatatta acataaacac ttattaaaat aaaattattt atttatatga tcatttctta 60
ttatagaaaa aaatttaaac attgatcata aaagtatgtg agacttttaa tagttttagt 120
aatttatact cgttttgaaa aattcaaaat acaacatata caaaaaaact aaaattttaa 180
tatatgatta atgtaattgt ttaatttata ataatagtaa agaattaaac aaaaattata 240

gaaagcatac atattattag caaatcttca ttatttaaaa tcattaatta ctatatatca 300
taatcacatt aggtaattct gtaggttttt atttaagaaa ataatatata ataaatagca 360
accttgctat atcatatgat atcatatagt tggtattaaa tgtttctagt gacatataaa 420
aatcgaattg gacgaacatg tttttcaatt tcagtgtggg actgacacat atgactaatt 480
aactatctaa ttgattgaca cataagcaaa atatattttt taactattac aaaattaagg 540
ttatatcttt tcaaatgttc ctcaattaat atatagggga ttgttcataa cccgaaacga 600
caatcaattt gtttacactc aaacactgat agtttaaact gaaggcgggg attggggagg 660
tgtgtgattt gcttagctta tgatatgttt aaacatgaag gcgggaaacg acaatctgat 720
cactgattag taactaaggc ctttaattaa tctagaggcg cgccgggccc cctgcaggga 780
gctaagccgg ccaatttaaa ttgatatcgg tacatcgatt acgccaagct atcaactttg 840
tatagaaaag ttgccatgat tacgccaagc ttggccacta aggccaattt cgcgccctgc 900
agcaaattta cacattgcca ctaaacgtct aaacccttgt aatttgtttt tgttttacta 960
tgtgtgttat gtatttgatt tgcgataaat ttttatattt ggtactaaat ttataacacc 1020
ttttatgcta acgtttgcca acacttagca atttgcaagt tgattaattg attctaaatt 1080
atttttgtct tctaaataca 1100

<210> 213
<211> 1226
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 213
gttaattata gatatatttt aggtagtatt agcaatttac acttccaaaa gactatgtaa 60
gttgtaaata tgatgcgttg atctcttcat cattcaatgg ttagtcaaaa aaataaaagc 120
ttaactagta aactaaagta gtcaaaaatt gtactttagt ttaaaatatt acatgaataa 180
tccaaaacga catttatgtg aaacaaaaac aatatgtcga ggcgatcgca gtacttaatc 240
agtgatcagt aactaaattc agtacattaa agacgtccgc aatgtgttat taagttgtct 300
aagcgtcaat ttgttgtcgg caagatctct gacactcaac taaaatgttg gattttccct 360
ttcaggtgta tgctcacaag gtctataaat atcttgagac tccactgctg tctctgagtg 420
agataagaga caacgaccgt attgtcgcat ataggttcaa ccagatgcac agaggaccag 480
gaaaagccaa actagagatt cttcactcgg agcagaaaca gtaagcattc gagaattctt 540
taggttctgt ctatctttca aatctcacag gtctgatttt ggcagagacg cagagatttc 600
tggaaagtta tttggaattc cccttgttac ttatgtcaac tcagaacgac atagtggaag 660
tgacattgat gcaattattt ctggattgct atcaccgcta caccggactc attcatcatc 720
tggaagctta gaggatacta cagttggtga aaaagagttt tctttcagcg tcttctggtt 780
agatcgttat tcttccagtc tcaagccact tgagtccgat tttgttccga atcctcttag 840
tgctacaagg ctcgtagtca agtgggacga gaaagagcat gaaaaatatg attcaagcag 900
ctacttgaat gatctacctg aggtttataa agcaacttcc tcggtggcgg aaaaggtttc 960
tttgttttca tgcttggaag cctttctagc agaagagcct ctcggaccag atgatatgtg 1020
gtgttgtcct gcttgcaaag aacacaggca agcgaacaag aagctgaact tgtggaagtt 1080
gccagagatt cttgtgttcc acctaaaacg gttcgcctat accagatttt taaagagtaa 1140
gattgatacg ttcgtggatt ttccgattca tgacttagat ttaagcaagt acgtgaagaa 1200
taaagagggt gagtcgtatc tttacg 1226

<210> 214
<211> 2100
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 214
acatcatctt gcaaccgact tgaataatca cgtccaccaa cctaacaaca gaggagaaga 60
ggttatcatc gcagatggct ccctcttctc atcgcagatg gctcaggtct tccaatcaca 120
catattggtt cctccattga tcacaaaaat tttaaaggaa tttttaacat tttttgtaat 180
ttaaagttgt tttaaaaatt tcaaagtata atatataaga aaaaatctaa tttttattat 240
tatatggtta atgtgattgt ttattttttt aataatataa aattaaacaa aaatgaggaa 300
agatgcaaaa gttgttatca aatctttatt attcataatc attaattgtc atatatatgt 360
tagttatatt aggtaattcc gtagctttta tttaaggaaa aaatacacac tgtttttatt 420
ttgggttaat ataactttcc ctagtaattg gattttacac caacattttt tcaattgatt 480
cttaagctgc catgtaagct aaatttgcat actaattaag tgacacctaa gtagggtttc 540
tttttaatta gtacaaactt aatgttacaa ttttttaaat gatcttcaat taatatatag 600
gggataagac acaacctcct cttatgattg tgtaatatta atagtcctca tataccttca 660
attatttata tgcagtagta gatgcagtat gaaggaagga ggtgtgattc ggagatgcag 720

tagtagtcaa ttggaaccga agaatgagag gaggaggagt gtgggttatt gtcgctgcca 780
gatgatgtgg ctttggattg cctggttcag gtgtcgagac tggacctggt gggcttagcc 840
atggtttcca ggagccaccg gtttgtggca gagtcccgca atatcatggc catgagatat 900
cggctgggta acttggaccc atatttgtgc gtatttatac actccaagcc caaggtggtt 960
cgtcctccac accctgcaac attggctcaa accggtccat tcaagcttgt atccggctcc 1020
actagccgga tcctgttttg tgacgacgga ttggggtatc tattgtatcg gtggattcat 1080
gaacggcaag cccacatcgg aagtcacgtt ttttaatgct atcgaccaca gcccttaccg 1140
agctgcccca ataaagatgg ctcgaagcgg atcatccgca agcttgataa acaagaagaa 1200
ggtatttgta tttggagggt gttgggatgt cgctaattct tcaaactggt tagagttata 1260
tgattttaaa actggaacgt gagagttttt gtttgtattt acgcccaaga tgcccctcaa 1320
catccaacaa agtgtggtga tagaaggcaa ggttgtttat ggggtggatg gggatggtca 1380
aatctttcac ttcacaccga gtactactag ccttatgttt actacagacg gaatagttga 1440
gcctaaccca gaaaatagaa acgattggtt tttatttgag gtaataatgt gccgtggtat 1500
cggcgggaga atactgtggc gttggccaga tgagattctt tagaaagaag tcaaaggttt 1560
ggaagagctg cagcaacaac acatcatcaa aatctgctcc ttctctgaga agacgattgc 1620
catcttctgg gatgcccggt ggcctcaaca aggtctagga gctttggtat gccgagattt 1680
ccatgaagag acaccaggga gacgaggggt ggtggaaggt ttgggggaac attgagagtt 1740
ccgctgctgt tatctcagac tcatcgcata gttcctttaa cttgttatat gctgctactg 1800
tctttgcctg aattactatt ctcaagcaat cctttggttt tttatataat ttgtttctat 1860
tttatctttt gattgcaaca tgttatcaca aaccaaacta atcggtaacg ttattgctta 1920
aacatatcat aagctaagca aatcacacac ctccccaatc catggatatg ttctctcttt 1980
tctcaatcaa tttgtttaca ctcaaacact gatagtttaa actgaaggcg ggaaacgaca 2040
atctgatcac tgattagtaa ctaaggcctt taattaatct agaggcgcgc cgggcccccct 2100

<210> 215
<211> 2065
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 215
gtatcactat ttttcagcat gtagtccatt ctcttcaaac aaagacagcg gctatataat 60
cgttgtgtta tattcagtct aaaacaaggc gcctactacc ggtaattccc gggattagcg 120
gccgctagtc tgtgcgcact tgtatcctgc aggtcaatcg tttaaacact gtacggaccg 180
tggcctaata ggccggtacc caactttatt atacatagtt gataattcac tggccggatg 240
taccgaattc gcggccgcaa gcttgtacac tagtacgcgt caattggcga tcgcagtact 300
taatcagtga tcagtaacta aattcagtac atcaaccgta tttagtttta atttttataa 360
gatttttaca caattataac tttgtttaaa ttaaaatttt attataatat ttttaggtaa 420
ataaaaagtg tggttctaat ggtaaatttc tctgtctgct ccatctatga catcttttgc 480
ggttatcacc tttgctcttt gttagcatca tgtttttgt aactttttta attctggttt 540
gtggcagtgg gctccttttc atctgttttg gcaatgacac agctggttgc ttttgaaatc 600
atgctctgtg tttatggctg gtgtgttgtt tatgatacat ttggttgtgt ccctgaatcc 660
ttgtgttgca gttgtttatg atagatttgg ttgtgtccta ctattgtttg cgttcggatt 720
gcgattttgg actggacttg gtttcttagt tgtatttcat ttcgaaaaat tgtaactcgt 780
tatatttttt ttttcttttt gttcttaggg aagaatgatt attgctcatt tatgtgatga 840
gctgaaagaa ctgaaaacaa ttatgtgcat ggtaatattc ctttgcactt gcaaacgcaa 900
taaccgcaag attgaatgat gggtaggtaa attttttttt tttttttgt ttatggtcat 960
tgcataacat acttttattg gaaattgtct tctcttaaga atgaatgggt ggtttgagac 1020
tattggagat aaaatgattc ttgggagtca gattctttta ccaatatgtg tacacttttt 1080
taagatagat gtttaatgta gtatttttat ttcttatatt gtgtatatac ttattatttg 1140
ttttttcctt aattatatat ttacttattt tattttttt gtttttatat caaatggtaa 1200
tattacgata gatgtttaat gtaatattta tgtttcttct attctatatt tacttattct 1260
ttatttttg ctgtaatata ataatggaaa tgataaaaat gtataactat agattttca 1320
gatagatgtt taatgtaata ttccatttct tatattgtac atttaattat tatttatttt 1380
tcttatatta tatatttatt tattttaatt attttgcctt tcatcaaatg gtaatattat 1440
gatagatgtt taatgtaata tttatttttc ttctattgta tatttacatc tttttatgtt 1500
ttcttataat ttaatataaa aatgtaaaac tatacatttt taaatagatg tttaatgtag 1560
tatttccatt tcttatattg tgtatttact tattttaatt ttcttccttt tatatcaaat 1620
agtaatatta caatagatgt ttaatgtaat atttttgttt cttttattgt atatttactt 1680
tgtttttata atgtattaat gtcgtgtggc atcttttgga agaaggattt tatgttgaga 1740
tgaacattcc atagagcctc aaatagtctc ttttattagt actagaggtt ggtccgccct 1800
acgggcgggt taattacact aaactatttc atattagaat atattttaat tttataaaat 1860
atttgaatat ttactttata ttaaaataat aaatacaatc tatttttatt tctttttatt 1920
ctaagatcat atcataactt ttattaaaat tttttggttt taattataaa gatcaataac 1980
attttttct gagaaaacaa aattaataaa ttaaagttaa tgaacattta atgatttata 2040
tttttctatt tgatttatat ttcaa 2065

<210> 216
<211> 1500
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 216
```
atgtatgtgt agattcttgt aattttgcaa taataaaaaa atgtggctta gattaaaaaa      60
aagagttata tatgttgttt ttacattagg tgaggactct gttgtaaaaa aaatgtgatt     120
tgttttttta tagatgtggt aattttatat atatctcaag gtctcttgtg gattagatag     180
agagtgaatg attaaatgtt tttaaagtgg gctctcctat tgcaataatc taaaaataaa     240
ggtttgtttg ttatacacaa taatttttaa gagagaattt taaacaaaaa atattactcc     300
aatcaaaaat agcattttct aaaaaatatc tcattctcaa ttgatataat ttcttctttt     360
catttgttca ttttatacta cttatttttg gtttaagaaa cttctaaaaa accttcaact     420
gaaaatgctt ttatgcttct aacatttatt tcaaagactt ctgatttatg tttggaacaa     480
atgaaataga gaagcaattc catgaattga agtgattaat gtatgttttg caacaattaa     540
aaatgttgct tgtaagtttg caacaattta aaaataaaaa ggtctaatct gtttttcatt     600
tttcattttt tcacatttag gtgatgagta gttgtagtat aacttaaatg gtggtttgtc     660
ttgttatatt tggttgtcat ttctttattt caagatcttt gatttttttt ttttacaaaa     720
cacatggaat gaattccatg catttgttaa ttgttttgga attttttttg tactctattt     780
aggtgttagg actctactgt agtatgacct aacatagtgg tgatatgttg atcaaatttt     840
gtgtgacatt tatatgaagg tcttttgatt tatatttagt aaaatgaaat agagagggaa     900
gtttatatga aggtctccag aaattgaagt gactcatgaa tgtttagtta agtaaagatc     960
aatggacttt catcaccaaa tatatatttt ttaaactata caaaaaaaaa tcctttttat    1020
tttaaagaag tttaattata tttaaaaatg atttaaatgt acgtaataat tataaacaga    1080
atattctttt gtagagtgga cctaatgcaa gtaggcaaga tccgacaaaa caagttaaag    1140
acacacccca ccaaaagcaa ccaagagaga cgtctttaat gtactgaatt tagtaactga    1200
aggcgggaaa cgacaatctg atcactgatt agtaactaag gcctttaatt aatctagagg    1260
cgcgccgggc cccctgcagg gagctcggcc ggccaattta aattgatatc ggtacatcga    1320
ttacgccaag ctatcaactt tgtatagaaa agttgccatg attacgccaa gcttggccac    1380
taaggcaaat ttcgcgccct gcagcaaatt tacacattgc cactaaacgt ctaaaccctt    1440
gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa atttttatat    1500
```

<210> 217
<211> 1948
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 217
```
cggccgagct ccctgcaggg ggcccggcgc gcctctagat taattaaagg ccttagttac      60
taatcagtga tcagattgtc gtttcccgcc ttcagtttaa actatcagtg ttgctttagt     120
ggtcaatcaa aagatgaaca gtatcttctc gatcgatgat ttctccgatc ccttttggga     180
atcttctccg cctctcgatt cggactcggc caaggccctc acggcggagg aatggaccgt     240
ggagatgttt ttcgaagaga tcgcttcctc cgtgacctct gcgcctgtcg gatccaacaa     300
caacaacaac aacgcgatcg tcggagtttc gtcggcgcag tctcttcctt ccgtctccgg     360
acagaacgat ttcgaggaag acagtcggtt tctccgtcgc gaatcagatg attaccgtcg     420
cgttcttgag aacaagctcg agactgagtg tgcagctact gttgtagctc ttagggtttg     480
tcttctgttt ctcttttttt tatattgcat gtgtaagaag aagaagaaga tctgaatctt     540
aaagctttgt ttgttctctc tgcttgtgtt gtgtaggctg gttctgtgaa gcctgaagat     600
tcgactggtt ctcctgagac tctgtttcaa ccagctctgt ctagtcctct tactcaaggt     660
aataggtgct catcatgcaa attagttttt tacactacat agcttgtctc ttagcttcac     720
catgtttgaa attttttatg ccaagaaagt gttctaaaaa tcggtctagg cgcctagtcg     780
gcaaatcggg tctgtacgaa atgatttttt caaatcgatt tgaaaatcgg tctagacgtc     840
cgcctaaaca ataattatag cgataaaatt aaggatttgt aatgtagaga tggaaaaaaa     900
aaattttgtt caaatagaga aggaaaatgg ttctttagag aagcttgaaa ccatttcaag     960
tctccttgat atattttttt tgttggagca agtttctaat tttatcataa agtttcaata    1020
ctttttgtga tattttcctt gaaattaatc tgactttttt aaggccaata agattgggat    1080
ggtgttagtt caatatcttt ctctttgttt cgagtcttta cacatagtac gtttaatggt    1140
ggtaggttct ttggtgacgc ctggagaagt tggtgtcact tcatcattac tagctgaggt    1200
gaaaaaaact ggtgtaccga tgaagcaggt tactagtgga tcgtctagag attattctga    1260
tgatgacgac cttgatgaag agaatgaaac cactggttcc ttgaaaccag aggacgttaa    1320
aaaatctaga aggtaaaatg attccttgtt tcttgtcttt tgatgtttat ctttatagaa    1380
```

ccttgttgtt tgtaggatgc tttcaaatcg agagtcagct aggcggtcta gaaggagaaa 1440
acaggagcaa acatgtgatc tcgaaacaca ggtttctata aatagatcct ctcaacctcc 1500
tattaacatc tccaaggata ttaatagaaa cttaattttt gtgtgtgttt tgataggtta 1560
atgagctaaa aggtgaacac tcctcacttc tcaagcagct tagcaacatg aatcacaagt 1620
atgatgacgc tgccgttggc aatagaatac taaaagccga catcgagaca ctaagagcta 1680
aggtaataac accttctttt ttttcataac cacactaatg ttttgttact ataactaatt 1740
gtatttgatc aaggtgaaaa tggcggaaga gacggttaag agagtaacag gaatgaaccc 1800
tatgcttctc ggtagatcaa atggacataa caacaacaac aatagaatgc cattaactgg 1860
taatagcagg atgggtggtt cttcatgcat cccacctttt caaccgcaat caaatccaaa 1920
catgggggga ctaacaacaa ccattcta 1948

<210> 218
<211> 1600
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 218
caagaccaca agattgcatc tctttgaaag tctcttcagc ccttttgaaa tctccttggc 60
aacaaaatcc attaacaaga gatgagtaag tcaccacgtt tggcttacac ttggtcttac 120
ccatgtctcg aaaaatcttt aaggcggtag tcatatcctg ttgcttcacg tacccatcga 180
tgattgtgga ataagtgaac tcatcaggta caagtctttc ttcggtcatc ctattcatac 240
acatcaatgc ctcattcaac attccggatc tgcaaaaccc ctttatcata gcgttgtggt 300
gcacgacatc aaccttcaca cccttttcaa ttgagagaga ggaaaccttc tttgcttcct 360
caaaatcacc gcttctgatg aatccatcta tgagggtagc atacacataa gcatccggtg 420
aaattttccg gtctaacatc tccaagaaga ggagcttggc agatgaaaac ccacctctct 480
tacacaaccc actcatcaac atattgtaga tggcagcatc cggtgaaact cctctctcta 540
tcattttacc tttcatctta attgcatcat ccatatgacc tgaagcgaca agaccatgga 600
taagaatccc atacgtaact atatctggtt tgcaacctct ctcagccatc tgcagaagca 660
acttagaagc aatatcatac tctttgactc tgcaataacc ttgtattaga ggggcatagg 720
ttatattgtt ccgaaccaac cctctctttg cagcttcatc caaaatccca acagcatctt 780
ccatcctacc ttctttacat aaacgattga tcaaaatatt atatgttgct atatcaggct 840
tgcaaccatt agctactatc caccgtatac tctcagctac ttcaaccttt aaaccatgcc 900
tatacttagc atccataata ttgttcagaa accaaacact gacaactaaa cccctttctt 960
tcacttcctt caaaagccga tcactcgcca cgaaatcccc tttcttgcag aacccattaa 1020
tcatcgcccc caaaagtctc caagagtcgg cataaacccc ttggacttca actccttgaa 1080
aaccagactc gcgttctcaa catcagccat cttgcagtat ccactaatga tggtgttgta 1140
aaacacaata ttcggaacac aacctttccc ccatcgctct tcaatcagct tcctaccttc 1200
ttctaccttc ccttcgctac acataccttt gagcaatata caagtgctgt aattatcacc 1260
tctctcacgc agttcggatt tcgttaaaat ctaatattct acaaaccctt ttatttttct 1320
tttgaattac cgtcttcatt ggttatatga taacttgata agtaaagctt caataattga 1380
atttgatctg tgttttttg gccttaatac taaatcctta cataagcttt gttgcttctc 1440
ctcttgtgag ttgagtgtta agttgtaata atggttcact ttcagcttta gaagaaacca 1500
tggaagttgt tgagaggttc tacggagagt tggatggaaa ggtttcccaa ggagtgaacg 1560
ctttgttggg atctttcgga gttgagttga ctgatacccc 1600

<210> 219
<211> 955
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 219
ttttgaacaa gtaaatccaa aaaaaaaaaa aaaaatctca actcaacact aaattatttt 60
aatgtataaa agatgcttaa aacatttggc ttaaaagaaa gaagctaaaa acatagagaa 120
ctcttgtaaa ttgaagtatg aaaatatact gaattgggta ttatatgaat ttttctgatt 180
taggattcac atgatccaaa aaggaaatcc agaagcacta atcagacatt ggaagtagga 240
ttaatcagtg atcagtaact attaaattca attaaccgcg gacatctaca tttttgaatt 300
gaaaaaaaat tggtaattac tctttctttt tctccatatt gaccatcata ctcattgctg 360
atccatgtag atttcccgga catgaagcca tttgtcaacg tcgttgtttg atttcgttaa 420
ggggagagca gtccaagtgt gtttttaatc tcagataggc ctaacatcta gatttatttc 480
agactaaccc aaaaccgaaa cttttgcatt caagtcatct ttcgtgttga ttcgtaattc 540
tttttttcac attcaacttt ttggtagcag caggttcaga agattcattc ggtttttcaa 600
tgtttcagag taacactaga tttgtttcag attaaaccga aaaatcggat tcgttcagaa 660

gttttatttg gtatgactat gttccggtat gtgatcaata agaaccactt gagttcggtc 720
gagttgtttt ttttttttga acttttgtat ctgatcagtt cggatagact cgaaaaagga 780
aaagtaaagt ctaatagaca tcaatatttt gacaaaatat caaaaaatca atatacaata 840
ctaaaagggg atataagcca tggagagggt atccacgtaa gataggaaaa tcaaccaatc 900
agagaaccca aaattttcac atcatctcaa ttatttttcg taaaaaatac aatac 955

<210> 220
<211> 2199
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 220
aaactgaaac tttcaaattc caaagttcga tcagtgtttc taataatcag caaacctgtt 60
gaagaagaca aagtaattgg caaagtaaat tccattattt catacccctct tctttgattc 120
tagtgaagaa gacaaatcaa aatattaatc ttctgctaaa aaactgaaac tttcaagttc 180
caaatttcca aaaaacacat ttctccttaa tagacctttt aacatcaatt caaactacag 240
tccacaagct tttcacatga actggcacaa taaactgcat tcatattctt tggttctagt 300
gaagaagacg catcaaaaac tgtagcagct aaaaaaaaaa ctgaaacttt caagttccaa 360
agttgtacca gtgtttctaa taatgagcaa acctgttgaa agcttttgac ggttttgcca 420
agactcttgc caatctcagg aagcttctta ggtccgaaca gcaacgcagc gactccagcg 480
atcacagcta gctcagggac accgagacca aacagagcat tacaagttag tgcatttctc 540
ctctgctccg gtcggaacgc cactagagaa cgggtgtatg gtcgagtcgt cacagtgaag 600
cagttgtagt agaaggaaga gcgagatgat gagagaggca aagaaactgc tgtgagagaa 660
gaaagagtcg caacatttgt cgccattact gctatcttct ggttctgatg ttatgtgtgt 720
tttctatgag tttttatcca attaaatatt cagaaatgtt atagaaacta aattaatctt 780
cttattgtct caactctaca tgcagtacaa aactcatctc atacgtagaa aagtagaaat 840
taataggaaa actagatcat cactcgcccg ggcggacgga tttttattcc tttgcaaacg 900
cggattgtaa tttttttatt gtaatgcaaa aattgctata aaacttgtat tttgattttt 960
tttgtgaatt atgaagttaa ttttttttaaa acaattatta cataattgct cagtgaattt 1020
tattatattc taatgtctaa tatattttgt gtattaaaat atgagatcca ccgtaaaaat 1080
tcacttaaaa gaagctgtta tgtttctaat ttaataagat agatttttaa taccatgttt 1140
aaaatatata ttataaaccc atgaactatg ttattttgta tgaatactta cttaaattta 1200
tgtttagaat ttataaaatt gtacataaaa ttatttaact cttgatgctt attattggtt 1260
gatgatatat tctctaataa attatttaat tattcaatat tgacatgtca agctgtttaa 1320
attgatgagt ggggtcggtt gaaatttaaa atttccatac caatataaag atgaaattcg 1380
atgttattgg tttggtgttt cattatattt tggaaagaaa ccgataataa ataacagcac 1440
aataaacaaa tgaatatttt taatttagtc taatagtcga tgtatatatg taacggtccc 1500
acccacgatt ttcgtggtta cttgttagtc catatctcaa attaccattc taccgttaat 1560
gaggagtatt tattttttga aaatacaatg gcattttaag taatatgcca tgtaaaagta 1620
agggtaaata ttagcagtga tcctgaatta ataatattga tactagcaaa tgttttatta 1680
ttatcaaatt tgcagataaa catgattaat tctactaagt tcactaacag gaattaaata 1740
gttttagaaa atttagggag tgtattcaaa gtttaaggtg atttgtatta aaatgacagt 1800
tattcaaaca tgatttttaa atattcaaaa atctagtgtt attaaaattg ttatttgata 1860
aactacccag tcagcatcat cacaccaaaa gttaggcccg aatagtttga aattagaaag 1920
ctcgcaattg aggtctacag gccaaattcg ctcttagccg tacaatatta ctcaccggtg 1980
cgatgccccc catcgtaggt gaaggtggaa attaatggcg cgcctgatca ctgattagta 2040
actattacgt aagcctacgt agcgtcacgt gacgttagct aacgctacgt agcctcagct 2100
gacgttacgt aagcctacgt agcgtcacgt gagcttagct aacgctacct aggctcagct 2160
gacgttacgt aacgctagct agcgtcactc ctgcagcaa 2199

<210> 221
<211> 1748
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 221
aaacattttt tcagattttg aacaagtaaa tccaaaaaaa aaaaaaaaaa tctcaactca 60
acactaaatt attttaatgt ataaaagatg cttaaaacat ttggcttaaa agaaagaagc 120
taaaaacata gagaactctt gtaaattgaa gtatgaaaat atactgaatt gggtattata 180
tgaatttttc tgatttagga ttcacatgat ccaaaaagga aatccagaag cactaatcag 240
acattggaag taggattaat cagtgatcag taactattaa attcaattaa ccgcggacat 300
ctacattttt ttactgctat tctttcatat tagcaactgg ttgattactg aattagtaca 360

gatgtaacta acatatatat tggatattat tattatccaa aagagctatt caacctttta 420
agcatatgta tatacatgtt taattgattt tattagtatt tcttgctctt gttgttttgc 480
ttatattttt gtaatgattt atttattttt agttatttag ttttatcaaa gtggtgatta 540
agagaagcca catgactaat accttgttct ccaacttttt ggttaaaata aatttatcta 600
agatatattt tgatcgattg atatgaatgt tattataaca tttacaattt aaaaaataca 660
gttttttctt tctcatttac attgtttcct ttaggggtga acacttctgg ttattttatc 720
ggttcagttt agattcggtt cgatttggtt aattcagttt tataaatttt tccaactgga 780
gtaaccataa ttaattatgg tttgaatcgg tttaatttac cttaatcaga tccagtttaa 840
tttttttttt aaaaaataat attttataac acatggtgga tataaaaaat gaactatgta 900
aattaaatct aataaaaaac tgaaacacaa tcttaaaaaa ccacaaaagt ttataagaac 960
acaatcaaac caaaataaat agaaaactaa aaacccaaca ttgttaacac agttaatagt 1020
gactttagtt ttagaattta gtatattgta tattgctatt atgtttaatg taaataataa 1080
caaaaataca ttgttttttt ggttcagttc ggtttggttt gttcgagttg agaaaatctt 1140
aaatcaacct atttgataat agacgttggt ttggttcgga tcgatttcgg ttcggttggt 1200
ttgatttgac tcggtgttca ctgaatacaa tttattctat aacttatttg tcatacttta 1260
ttatcctgta atagagttcc ggtttaattt ggggtttggt ttgtgtttga tccggttttg 1320
ttaactcggg tttgataaaa ctccgaatta aatttggttt ggttggtacg ttttagttcg 1380
gtttaatttc caaatctata acacttgaca aaactcacat cctcgctctt ccttccccca 1440
accctaacaa aaaccttcac gctggggaga aaaaaagcaa caaccttcac cgtcgtctgc 1500
tgctcctcac caccgcgccg tcgaaaattg acctctaccc attactaggt aagcttccca 1560
gacccatcct acatcctcaa ttcactaaac aaacgctaaa gtctctacct ttatctcctc 1620
caatcgtaga tctaaagcta tggctatctc ccaagatctc tacccttccc aagaagacct 1680
cgtctacgag gaagagatcc tccgaaaccc cttcagcctc aagctctggt ggcgctacct 1740
catctcca 1748

<210> 222
<211> 1500
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 222
aaagagaaag caaagtggct tcgccgtgat cgccgagaga ggtcagaagt aaattaaaaa 60
aaaaaaaaaa tcaagagcta aggctcgaga gagatggcgt catcatagac taatcaccgt 120
tagaagatta gtaggaaaaa aaaagatgac acagagacga aagatcttaa cagttgaaca 180
cgtggcggaa aagcgaaatc cgatttaaca gatcggaaaa taaaaaccgg cgagattaaa 240
gaagaaagga gatagagaga agaggtacct tagatccgga tcctgtagat gtggagcagc 300
tcgcttggag actggtgtcc tcgaatccat cagccgaggg agacgcagat ccgccgccgc 360
tccacgagag cggcgtcttc ggactgcctc tagcggaatc aacatccttc ttcaacgaaa 420
cgacaccaaa tcttgacgac cgagaccgcc gttgacggac tccccaccgc aacggaggaa 480
ggttcgtcga tggatcttcc gaaaccaccg tcccagcatg cttcagccgg ataagaagct 540
ccacgaccat ctcgtcgtcc gtcatcgccg ccgccaccca ctcatcgttg accaacatct 600
tagccgctgc cgatgtaact ttcttcatcg acgctaactg atcaaatcta cagctcccgg 660
agaaaaaggg aatcagatac agtatagaag gagcgagaga gaatgaaaga gaagttacag 720
aagagagaga gaaaatgacg aagaaagaca gagggaagtt tgatgtatcg atatagagga 780
gagaaaaaaa gatacatggg tggtgttata tacgaggcta tctaacatta ttcttctttt 840
tatttttatt tttattttta tttttccttg tttcattttc atttatattt tgatttattt 900
tccattttgg aaatatttta atcaaataca atgtgggacc ttcttggaaa gtatatctaa 960
aattatatgt gaagattctc ctaataaaat tatatgtgaa gattctccta ataaacctcc 1020
agtcagcatc atcacaccaa aagttaggcc cgaatagttt gaaattagaa agctcgcaat 1080
tgaggtctac aggccaaatt cgctcttagc cgtacaatat tactcaccgg tgcgatgccc 1140
cccatcgtag gtgaaggtgg aaattaatgg cgcgcctgat cactgattag taactattac 1200
gtaagcctac gtagcgtcac gtgacgttag ctaacgctac gtagcctcag ctgacgttac 1260
gtaagcctac gtagcgtcac gtgagcttag ctaacgctac ctaggctcag ctgacgttac 1320
gtaacgctag ctagcgtcac tcctgcagca aatttacaca ttgccactaa acgtctaaac 1380
ccttgtaatt tgtttttgtt ttactatgtg tgttatgtat ttgatttgcg ataaattttt 1440
atatttggta ctaaatttat aacacctttt atgctaacgt ttgccaacac ttagcaattt 1500

<210> 223
<211> 1323
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<220>
<221> misc_feature
<222> (578)..(578)
<223> n is a, c, g, or t

<400> 223
actcttgtaa attgaagtat gaaaatatac tgaattgggt attatatgaa tttttctgat 60
ttaggattca catgatccaa aaaggaaatc cagaagcact aatcagacat tggaagtagg 120
attaatcagt gatcagtaac tattaaattc aattaaccgc ggacatctac atttttgaat 180
tgaaaaaaaa ttggtaatta ctctttcttt ttctccatat tgaccatcat actcattgct 240
gatccatgta gatttcccgg ttctttttct cagactactc actgcccgaa gccactacta 300
ctacacacat tattatctct ctcacatctc tactatttac tcttggattc cgcaaagtaa 360
gtaaaaaaaa aagaaagcaa actctgcttc tcaaatctct ctctacccat ttgctctctc 420
acattttcct ttgaccaaaa ctgaatcttt acttcaagca gcgtaaggtg ctcgctcctt 480
tttgttcctc tgactttggt tttgatatga agttttcatg aaactctttc attacacttg 540
ctttttgaaa aaaaatgatg tagctttcct ggaaaatnta gtttcttttc attatcttgg 600
gatcttgtga tagattaaat gttatgttta cagttcttca tacctggtgg tcaaactctc 660
tttttctttg tttttgtaag ttttaaggtt taatgtttaa agctatttct gtgatgcact 720
gtgattgttt gctaatgctt tactttaatc aatctgatga ttgtttgctt cactcaagtg 780
gtttttataa attagattct ccttttttcat ggaaaaaaat tcatccagga atccaaatag 840
attttatttt tttgcttgtc ttgtctttga gtggagtatt aaatctattt actttatatt 900
aaattttttt ttatgtaaaa agatatttaa actcaattat gtgattcatg atagtagttc 960
ttcaacgtct actaggtccc ctcctttcac gccaataatg gaggagatga tgaaatttaa 1020
catacaaaat tacagtttaa ccctcttgtg ttccatttag gattaagaat ctggtaggga 1080
cataaaacgt aaatctacca tattgtgtgc tgcttgtgta gtttgtgtag gacccttggt 1140
taccaacctt catgatgata ggttgtgaac attacatagt caagaggagt tccctttttt 1200
tatgacttta ttatagtcaa acaacttgag tagttaacat caatggtttc aatgtcaaga 1260
tatgagttaa gtctttcttt attttgtttg gttttatttg ggtaaaactc cagaaatgaa 1320
agc 1323

<210> 224
<211> 1100
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 224
ttgagttttt gaaatttata accctttgta aatctaagtt ttaggaaaaa gtcgttgaat 60
tatgaatcgt ttgcttttac cacaagctgc tcgatcaatc ttttagagtt ttcaaatcta 120
aatttaacac aaaaaaatca atttttagtt tttgaattat gtttccattg ctgcgacagc 180
ttaaaaaata atccattttt tatcgtcttc catcatttgt ctccagcttt cggagtggaa 240
atgagttctc ttagactcaa gttggagatg atttcaaatt ggggcgttgg aggaactttc 300
attctttaac agtttataaa gtttgtaaat catttacaaa gtttttaaat catttataaa 360
tgtttataaa ttatttgtaa gagcatataa accatttata aggtttataa aggtatgtaa 420
ataatttatg agggtttata aaatgtttat taagttcata aaaaggtttt ataaagttta 480
gaaacaattt ataacgactt attaatcatt tataaagagt ctataaacgt tttataaagg 540
gtatgtaaat gttttataga cccttataaa gtttgtaaac cctaatagaa ccccgacatg 600
aagtttataa aagaacagtt taggcccgaa tagtttgaaa ttagaaagct cgcaattgag 660
gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg atgcccccca 720
tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac tattacgtaa 780
gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga cgttacgtaa 840
gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga cgttacgtaa 900
cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt ctaaaccctt 960
gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa atttttatat 1020
ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag caatttgcaa 1080
gttgattaat tgattctaaa 1100

<210> 225
<211> 1413
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 225

atatactgaa ttgggtatta tatgaatttt tctgatttag gattcacatg atccaaaaag 60
gaaatccaga agcactaatc agacattgga agtaggatta atcagtgatc agtaactatt 120
aaattcaatt aaccgcggac atctacattt ttgaattgaa aaaaaattgg taattactct 180
ttctttttct ccatattgac catcatactc attgctgatc catgtagatt tcccggacat 240
gaagccattt acaatccatg tccttataaa tggtttatat actcttataa ataatttgct 300
tcttcatgcc tcaagaatat tactactttc aagaatagga aaatctgtgt actaaaaact 360
tcatctcggg ttctatcata ttgtggtact atcagtaggt gactctgtgt ttctatctgc 420
aacataaaag catgaaacta ataagattgt acaattattt tataagtctt tataaatgta 480
aacaatgtaa taaaatctca gacattaaat gaataagttt tgactattat tttataagtc 540
cttgaaagta ttaaattgta ataaacacct caaatatttt gatacttcca gcaatgagga 600
agtcttgagt actagaaacg tcaattcgtg tatgtatcat gtttgacata attaattgtg 660
atctatgcct ttccatttgt aacataaaaa catgaactca ataatttcta tacaataatt 720
tttttaagtt cttatgaaaa tgtaaaagga gttctaaata tctcaagggc attaccatag 780
acaaccttgt ttcgcacaat caaagagtgt gtacatatat gtttgcaata taaaaacacg 840
aaactttgtg attgtgtcaa agtaaataac aaagccttat aaataaaaca tgaccaaaga 900
gttaacctca gaaattgttg cacaaaaacg aagaaatctt ccaatttctt tatgtttgct 960
cataaaagag gccacttgga gatcatttct aataaaaact gaaagaacct cttttgtacc 1020
aaagaacctc ttttgtgtat tatttataaa ctcttataaa attgtatcca ttaataaaag 1080
tttataatta tttataagta tttacaaatt gtagcacaca caagatagca attgatgtag 1140
cttcctcggc taaaacatga tttcctgtaa caataccctt tctagctgat ctcaaggcaa 1200
aagtgaacat ttgtttcatc gcgttacttc ctcctggcat atctagtgaa agagccacgt 1260
ccttcaacaa gggatatatt gcctcaccct ctctgtagac tgtacagaga ccatgcttgt 1320
gatcagaatc aaacaaactc atttcaaggt ttagttttat aaatactact acttacctta 1380
actcttgtgg atttagaagg gaatgagaga agc 1413

<210> 226
<211> 2200
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 226
agctccccag aacaaaataa aaatcgaaac tttgacacta cgaaacgatc aattacgagt 60
gaaaagcgaa aaagaatcga actttaacaa caagagccgt cacaaaggaa gagtgtcaaa 120
ggtaccacag tattggacat cggtggtggc tcgaacaatc gttgagaaga cgaggagaag 180
aggaagaatc gcgattctcg acatcgttga tggaatctcg gaggggtgat cgatgatcaa 240
aagcccaaag gaggttaaac caggagcgga gcagagtaac tttacttctc ttttatattc 300
tcatggaatg taggcgtcat cgtgaccgtt cgtttagcta ggtcattctt gcctttacag 360
taaaacggac ggctagattt cgtttagaga agttatctga tatgaatgat tgcacctgat 420
tatccgtcat aacgaaccat caggattaac caactttgac tgcatacctt cttatttatg 480
acctcttctt ccttattttc ttaaagatat ttatgtaagg agaataaaat ttgaatacaa 540
ttcttttttt catgttggca agatctaaca tggattgtgg tatacagatt cactaaaacc 600
tcgtcacttt gtagatagca agaataatgt atagtctaga taacaagaat aatgtacatt 660
tgttcatgaa attatactga tgaattaaga accatgaaag cacatacgtt aagtttcaat 720
ataaataaaa ctatttgtta aaaatagaca tctatttgta ataattagag actaattcat 780
ttacaaactg tataagtgca ttattgtatt attttatttg ttgcgtcatg tatcaatata 840
attaatttc ttccttcggt tgaaaaaata taatctttta ttttagcaaa gggtttaact 900
aaagaaatat aattgctatc aaatataaat aaattataat ctcattaaac tgttcatgtt 960
gtctcaagaa tataccatta aattttattt gtataaggaa ccaaataaca cccgtgaaac 1020
tttacaactt gaaagtaata gtgtactcta agaatgtcaa caaaagttga aatgtaatat 1080
aaataaagaa aagacacgaa gtcaaacatc tatcgaccgg taacagcgtc ggcgacaggt 1140
gtcatcgccg gagacggcaa tggagacgaa cggcatacgg gacacgtagg atgaatcatg 1200
agccaagggt caacgcactt gtcgtggaac aaatggttac aatccggcaa aaccctaatc 1260
atatctgtct tcttgtaatc cgcgagacat atagaacaac acgacgtcgc agtggcatcc 1320
ttttgcaagc tataacccac acgagcctct tcgcacggaa ccttagagca tgcgcaacgg 1380
aggatgaccc cgaatcctta gcgcttaatg gttccattag ttttaatata ataataatat 1440
taagcttaat aaacgagcct ctgccagtca gcatcatcac accaaaagtt aggcccgaat 1500
agtttgaaat tagaaagctc gcaattgagg tctacaggcc aaattcgctc ttagccgtac 1560
aatattactc accggtgcga tgccccccat cgtaggtgaa ggtggaaatt aatggcgcgc 1620
ctgatcactg attagtaact attacgtaag cctacgtagc gtcacgtgac gttagctaac 1680
gctacgtagc ctcagctgac gttacgtaag cctacgtagc gtcacgtgag cttagctaac 1740
gctacctagg ctcagctgac gttacgtaac gctagctagc gtcactcctg cagcaaattt 1800
acacattgcc actaaacgtc taaacccttg taatttgttt ttgttttact atgtgtgtta 1860
tgtatttgat ttgcgataaa tttttatatt tggtactaaa tttataacac cttttatgct 1920
aacgtttgcc aacacttagc aatttgcaag ttgattaatt gattctaaat tatttttgtc 1980
ttctaaatac atatactaat caactggaaa tgtaaatatt tgctaatatt tctactatag 2040

gagaattaaa gtgagtgaat atggtaccac aaggtttgga gatttaattg ttgcaatgct 2100
gcatggatgg catatacacc aaacattcaa taattcttga ggataataat ggtaccacac 2160
aagatttgag gtgcatgaac gtcacgtgga caaaaggttt 2200

<210> 227
<211> 3137
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 227
ctgatttagg attcacatga tccaaaaagg aaatccagaa gcactaatca gacattggaa 60
gtaggattaa tcagtgatca gtaactatta aattcaatta accgcggaca tctacatttt 120
tgaattgaaa aaaaattggt aattactctt tctttttctc catattgacc atcatactca 180
ttgctgatcc atgtagattt cccggacatg aagccattta caatgagtca aaaaaaagtt 240
gttttgatga gtcactgcta caataatgta agatgataaa actcagacct caatcacaga 300
ggcaaacaac aacactcatt agtcatgatt ttttacccaa acaaaaagat gttatagagc 360
tttaagaaaa aaaaaaatta aaattacaaa tcggtctggt aagagtggta gattgatttt 420
tagaagttta tattccttct ttttgggttc ggtaagaatg atcatcatgc ctgtcttgtc 480
ttttacaatt tccgtaaacg tgcaatgatg tcagattggt aaaagtagct cagctttagc 540
taagcaaatt cgaattagtc aaaattaact aatttaatca tcatatatgc ttccactgat 600
atgttttcac attgcaatat ggctcagctt acttaatatg atgatggtta agaagaaatc 660
gtcaatcata acgagcattt gactagtgcc catgagacct ggtgatatgt tgtttgattg 720
aagcagcaaa aaaaaaaaaa acacctaagc atgtatttta tatatctatg atggaaatta 780
tgcaatccag ggtctagtaa cataactgat gaagctataa aaaaaaaacc atatctaaaa 840
aactatttat acaaaggcaa ataaagtgaa ttgctgctct acatgtcggc cacagatggt 900
acggatccaa tgtctatgga aaatttgatg cacgttagct ccttcttttg cgcgtccagc 960
atcttcattt gcagcgagta tgaaccctat aaagataaaa taaaaagagt agagaatctg 1020
tcaatctttt cctgatttaa tatgcacatt caaactagtc attcaatgtc tctatgcatt 1080
ggtcaaatac cactaaacta agcctaagac atccaatatg atacaagaga tgcttcaaga 1140
ttaggtagca agaaccaata aagaaaaagc gaatggaact tacaggagga gtgtaaccag 1200
gaagaacttg agaatgtgca accaagaagt ctccggtttc aacaggacaa gttgtctcag 1260
agcaaagttc atgagtctcg gagtgaatgt gccatccaaa gtatgtaact tcaatcacca 1320
gcttcccacc cgtaatccca cgccctttat taaaagaaaa acacatatca taaacaacac 1380
attcattatc atcacaaagg aaacatcttt ctatcattgg catcaaataa aaaaaagtaa 1440
aaaagaagta acctgtggtg gcagagatgg taaaggtagc tccgtagctg gctcgccttg 1500
agctataggg ttaggagata tattaacctc tttcactttc acttcatact ctgcgttctc 1560
ctctgcaatt aacaaaatac attacactat caaggcagag agctccccag aacaaaataa 1620
aaatcgaaac tttgacacta cgaaacgatc aattacgagt gaaaagcgaa aaagaatcga 1680
actttaacaa caagagccgt cacaaaggaa gagtgtcaaa ggtaccacag tattggacat 1740
cggtggtggc tcgaacaatc gttgagaaga cgaggagaag aggaagaatc gcgattctcg 1800
acatcgttga tggaatctcg gaggggtgat cgatgatcaa aagcccaaag gaggttaaac 1860
caggagcgga gcagagtaac tttacttctc ttttatattc tcatggaatg taggcgtcat 1920
cgtgaccgtt cgtttagcta ggtcattctt gcctttacag taaaacggac ggctagattt 1980
cgtttagaga agttatctga tatgaatgat tgcacctgat tatccgtcat aacgaaccat 2040
caggattaac caactttgac tgcatacctt cttatttatg acctcttctt ccttattttc 2100
ttaaagatat ttatgtaagg agaataaaat ttgaatacaa ttcttttttt catgttggca 2160
agatctaaca tggattgtgg tatacagatt cactaaaacc tcgtcacttt gtagatagca 2220
agaataatgt atagtctaga taacaagaat aatgtacatt tgttcatgaa attatactga 2280
tgaattaaga accatgaaag cacatacgtt aagtttcaat ataaataaaa ctatttgtta 2340
aaaatagaca tctatttgta ataattagag actaattcat ttacaaactg tataagtgca 2400
ttattgtatt attttatttg ttgcgtcatg tatcaatata attaatttc ttccttcggt 2460
tgaaaaaata taatctttta ttttagcaaa gggtttaact aaagaaatat aattgctatc 2520
aaatataaat aaattataat ctcattaaac tgttcatgtt gtctcaagaa tataccatta 2580
aattttattt gtataaggaa ccaaataaca cccgtgaaac tttacaactt gaaagtaata 2640
gtgtactcta agaatgtcaa caaaagttga aatgtaatat aaataaagaa aagacacgaa 2700
gtcaaacatc tatcgaccgg taacagcgtc ggcgacaggt gtcatcgccg gagacggcaa 2760
tggagacgaa cggcatacgg gacacgtagg atgaatcatg agccaagggt caacgcactt 2820
gtcgtggaac aaatggttac aatccggcaa aaccctaatc atatctgtct tcttgtaatc 2880
cgcgagacat atagaacaac acgacgtcgc agtggcatcc ttttgcaagc tataacccac 2940
acgagcctct tcgcacggaa ccttagagca tgcgcaacgg aggatgaccc cgaatcctta 3000
gcgcttaatg gttccattag ttttaatata ataataatat taagcttaat aaacgtaagg 3060
attggtccat aattaggtgc tggacggact cgtcattgtg ttacgtgtcc gaatttgagt 3120
ggattcgggc cggcttt 3137

<210> 228

<211> 1100
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 228
```
tatttttgtt catgtcttat tttctttttt cctaatgtaa ctatgagagg cttaaaaact     60
gtaaaatcag caaaacaata tacaattaca gtaaaaaatg tcacatacta agttctatat    120
atgactacaa gtctacaact caactaatca tccacataaa taattagttt tgtcataatt    180
atattatagt aagtacctga agaaaagata aagccatttc tggacaacat catctcgtat    240
tggcatcttt atacgtggac gacaaaatct atcacaataa tagttgctag atatagatac    300
atgaattttg taatatgatt aattaattgg cgcttcataa ctaaaataac taataaaggg    360
taaatgttct taaagtttca taattaatta tgtttcagag tggttgcatt atagtagttt    420
aaaattcaga agtgtacgcg acgagaaaag agatttgctg gtgactattg catcatcttt    480
gacatggaaa aaatcttaga taagaatagt ttgaaattag aaagctcgca attgaggtct    540
accaaaatta gaaattagaa agctcgcaat ccagtcagca tcatcacacc aaaagttagg    600
cccgaatagt ttgaaattag aaagctcgca attgaggtct acaggccaaa ttcgctctta    660
gccgtacaat attactcacc ggtgcgatgc cccccatcgt aggtgaaggt ggaaattaat    720
ggcgcgcctg atcactgatt agtaactatt acgtaagcct acgtagcgtc acgtgacgtt    780
agctaacgct acgtagcctc agctgacgtt acgtaagcct acgtagcgtc acgtgagctt    840
agctaacgct acctaggctc agctgacgtt acgtaacgct agctagcgtc actcctgcag    900
caaatttaca cattgccact aaacgtctaa acccttgtaa tttgtttttg ttttactatg    960
tgtgttatgt atttgatttg cgataaattt ttatatttgg tactaaattt ataacacctt   1020
ttatgctaac gtttgccaac acttagcaat ttgcaagttg attaattgat tctaaattat   1080
ttttgtcttc taaatacata                                               1100
```

<210> 229
<211> 811
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 229
```
aatttttctg atttaggatt cacatgatcc aaaaaggaaa tccagaagca ctaatcagac     60
attggaagta ggattaatca gtgatcagta actattaaat tcaattaacc gcggacatct    120
acatttttga attgaaaaaa aattggtaat tactctttct ttttctccat attgaccatc    180
atactcattg ctgatccatg tagatttccc ggacatgaag ccatttactc tgaccctact    240
ccacaaatat atttttattt ataaaaaggt ggccattgta tactatgtgt gcgtatacag    300
gaataaaaat gtgtcaatgt atatgtaaac tgattccatc ttatatgtaa tgtgcgtgtg    360
taaatgaaga tactagtatc catgtgtcgc ctacttgatt tgttcaactg taactcataa    420
tatctcaaga ttctttcttt tttttctacg aatatcgcaa tctataatac cattaaatta    480
ttgtaacaaa attggttgac atttataaaa tgaaaaagaa gagaagagca tttaaacacg    540
actgatgaaa gtccaatgta gctagataaa ccacgcgtgg tggtcaatgc gttccattcc    600
aaaaggatcc gagttcgaat ccgcaccaca ccagattttc actgcgcgtg gccatgaagc    660
tttcgcattc tcgctcctga gaatggttct ccattttttt tttccagtgt agctagatac    720
cggtctgaat ctaggtttat aatatgctga caatgtaatg ataattaata catcaaaaca    780
tgtgtttctg aaccaaaata aaaacttttt t                                   811
```

<210> 230
<211> 2900
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 230
```
gaaaaacctg catctccaaa aatgttcaaa tggcttaaaa acagagaaaa tgagtggaat     60
attagataga tctaccttta tagaacacac aaaaatacat atctaaaatt attaaatctt    120
cctttaaatg agtggaagat gagaaccatg tgatgaaaaa cctgcaaaac aagataaatt    180
agtaagaaaa acatgagaca gaaacaataa attgatataa agtttgatgt ttataagttc    240
aaagggatta aagagaggtt tgagagtttt agaacgagga acataccatt tttgttgcag    300
ccatttgaga ggagaagaga gaatgtgtaa atgttttttt atataaggag acaaaaattc    360
caataaggtt aaatattttt gatcagaaga cttactagac gacttacttg taagtcgccc    420
```

agaagacttc aatattttta gcgggaaact aaaatatttt tagcgggagt tagaagaccc 480
taaacataac ccttaaacta aattaactaa ctaaatactt cataaaatca aattaaactt 540
aaaaagtgtt tactatacac agaaataatc acatgtagat ataaatttaa tttttcaaaa 600
aaacatttaa gctttccaaa atctaaccct aagaatacat acaatactac aacatatgtt 660
gccaaaccct agaccaaaga atatcatgat tcactacttt cactcatcta tgttgaaaac 720
aattcaattt tattatatct taatttatat cacttaaaac tgtttataat tacatgattt 780
taattttccg tttatcaaaa tattttttac aaaatttata aattattttt aggatcaact 840
ataccagacg acttccatgg acgccgtaca gaagactaaa cagaatctca caagactcag 900
aagacgtagc ggggatatat tcataaaaat gagttctgtt tttttgtttg gtcacaaggg 960
gctggttgta atttcacaag gcttttggat tacttttgca tttgattcaa gtttgggtat 1020
acttttgcaa tcaaaatcaa gttttgagtc atatttggta aatcgcccta tataaaataa 1080
aattttaaaa agtaatgaat ctacatattt tgtaattttt aaaaaattta gttaacaatt 1140
ataataacac aaaacttaag aaaaagttat aattgtcgta tttttttctc ttttcttttc 1200
tatgtaatat ttttatataa gtaataatgt gaatagaatt tatcaaatca tatgttagaa 1260
taattattat ataattttat acatttaaaa atttaaatat aatcaagata tatacatgta 1320
tttatatatt accagatcag agcagatatc cgtttcccaa aattttaata tttgtgattt 1380
gcttcgattt taatggatat tgatttttag tatttttttg cttcaaaagt ttatggatat 1440
tcggaatttt cggatcgaat cgaaacgaat aacgcatcaa atcaaattta acggataaaa 1500
ccttagtaac acatgcataa accttagtga acttctcaag ctttcgattc tctatcttat 1560
ttatctatga aattaattaa cataattttc cttgaattaa cataattgga ctaacgcata 1620
ttcgagctga agtcaaaatt cccaaaactt gttcttgata tgagtaaaac tgttcgtctg 1680
atgtaaactc ttactgtagt tgtattacaa actaatgata aagtatgcat tttctatttt 1740
attataaatt tacattacta gttgataaca tattgacaac tagaaagcgt gagagagaga 1800
tactcggtaa gccgagatgt atatccacag ttggagtctt tggatttcat atccagaatt 1860
gggtcgcaaa ctttcagtac aaagttatga catctccatg gtatatatcg acgtgtctat 1920
atatcatatt aaagaaaggt ttgtagtatt tggttaggta caaatgcgat caacttttga 1980
atttatatcc atgtacatat ataccccttgg ttacaaggac acctacccat acatacgcat 2040
aagtgacaaa tagcaaaata tctacacatc gcatgacccc gttctttttt atgataaggt 2100
tgtgattttt gtggttcttt tttttcatct cttacattga ttcagtatgt tgtccaaaaa 2160
aaaaacagtg attcagtatt atatcgagta aattcacaag aacgtagcta caatgtagat 2220
gatttattaa caattttaca agagacaagc aaatgtcgag caatcatatt ctataatatc 2280
aacctaaaag agttaaatcc ataaaattag ttggcaacga gcgatagtat gaaagttagg 2340
tgatgacaaa agttgctata ttgcttcaac tatattttca taaatttatt tgtctggatg 2400
aaaaccacaa aattttaaaa atataatttt gattggtaat atgtaaataa cgggatccta 2460
tatttaaacc agtcagcatc atcacaccaa aagttaggcc cgaatagttt gaaattagaa 2520
agctcgcaat tgaggtctac aggccaaatt cgctcttagc cgtacaatat tactcaccgg 2580
tgcgatgccc cccatcgtag gtgaaggtgg aaattaatgg cgcgcctgat cactgattag 2640
taactattac gtaagcctac gtagcgtcac gtgacgttag ctaacgctac gtagcctcag 2700
ctgacgttac gtaagcctac gtagcgtcac gtgagcttag ctaacgctac ctaggctcag 2760
ctgacgttac gtaacgctag ctagcgtcac tcctgcagca aatttacaca ttgccactaa 2820
acgtctaaac ccttgtaatt tgtttttgtt ttactatgtg tgttatgtat ttgatttgcg 2880
ataaattttt atatttggta 2900

<210> 231
<211> 1800
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 231
tttttctgat ttaggattca catgatccaa aaaggaaatc cagaagcact aatcagacat 60
tggaagtagg attaatcagt gatcagtaac tattaaattc aattaaccgc ggacatctac 120
atttttgaat tgaaaaaaaa ttggtaatta ctctttcttt ttctccatat tgaccatcat 180
actcattgct gatccatgta gatttcccgg acatgaagcc atttacaatt gaatatatcc 240
tcacatatga aatatatttt ttttttacaa attacaccta ttaaattata cttgatcggt 300
catctgatat atttgaaaga accctatcag ccagctattc ataatttaca taaaagaaaa 360
ttacgtgctt aaaatctctc taaaaaaaaa aaaagacaaa gacatcaaac tgatccatga 420
aagtaaaatg gagtgtattt taattttatc ttcagaccaa tgttatcaat gtagcccata 480
tattaatact aaaacaactt ctgcacaaac acacgaatca aagcctcgtg tttcatcgta 540
gctttagcta aaatttccca aaagcaaatt caatagtatt ttactaggtc aaacccacaa 600
gagaaaaaga aagtcaatcc caaggatcaa gaaatgagaa gtgagaggag aatgctttat 660
tgggtttgct aataactaat aagacatgaa gcagactgaa aacatctggt tttgtccaaa 720
aaagaaggaa gtcagattcc aaaactgcgc acctacattg tttaatactc actcacacat 780
acattcatgt ttttactgtt tatacacagt caataattta tacacagctc catgttttaa 840
tatttaccca tctctctttt gtagtctatc gtagactttc acttgtgtcc ccctcatgcg 900
gcaacatcct cagcaacttg atttactata tacaataata caaatcataa gatatttgtt 960

aggagctggt ttgtaaatta tttcgataca atactgaagc gaagggacca gcaatctttt 1020
tagctgatca gaacaatctt actaacgtgt gtctttgtaa gaaaatccaa cttttacttt 1080
ttcaggaggg agtgtagcgg attatgtata aataactcga agagtggtgc acaaagttca 1140
agtgtttgtg taaaatgttc gacaagacat tgactaaagc attccgaaca tgtcaacaaa 1200
actacaattc taaaattgca aaaagctgct aaacggtgga atagcattta acacgcattc 1260
tataccaaac atttttttc ttgaacacca aagaaaccaa acctaatgtc aaccatcgta 1320
tggaaactat agaactaaat caaactaaca aattcttatt gtatattctt aaaaacatcc 1380
ttataagaca gtttttccaa atgaatcttt agacttcatt gtactaatat gtttaaaata 1440
atataattat gtatttaatt tcttgaaagt ttcgctgcta agaggcaatt atctttttat 1500
atttttttct ctcttatttt caaattctaa ttaattttct tggagagttt atccgatgat 1560
gatattctta tttcaactca atccacgagt aaatgtgtta gcaccacatc taaccatttg 1620
gagcttgtac tagctctatc tttccaaact taactttctt gagtgcttat ttatataaag 1680
catcagtata tggcccaacc caagaaaagc tgaacaaaat tagcaacaat agcaagggac 1740
gaactgcagc tcttcttggt tgtcgtgcct tccaattctc gactttccgt ggaagaacat 1800

<210> 232
<211> 1600
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 232
gatgaggaag aagtaataag gaaaagaagt ttgaagatca gatggtgatg gggaaagagg 60
atgatatggc agaagaactt gaagagggtg agatacggag tgtagatgag gagcatgagg 120
ctgaagaaga tgatgtgaat gagatggttg cttggagcaa tgatgaggat gaggaccttg 180
gttggcaaac aaatgaacct ataaggataa ataatgagct caaggtacct atccttcagc 240
atttcacatt tcataatcat agctgttagt ggttgagttc tttttattgt ctctaagcct 300
ttgttaactg tttgctaact ccaaacccttt tttaactttt gcaggagctt cctccagttc 360
cacctgtgga tgtcactttg gaaccacatc atgtcatgct tcctgttgga gttgttcttt 420
cggtatcata aaataaactc tacctgtgcg ctattgcttg ctaaacctaa aaccattgtg 480
atttctgatg ttccaggtac tgagcacacc actgacacaa gtaatagtgg agggaatgga 540
aaagcatagt cctttggccg aaggttctat cctatggata agtgaaagaa gaacgccatt 600
gggactggtg gatgagatct ttgcacaagt tgagtgccct tactatagtg tgaggttcaa 660
ttcagaaaac gaagtgccgg agggggttag tgaaggtaca cctgtctcat tcgttgctga 720
gtacgctcag catattctca atatcaagga actgcagaag aaaggttacg atgcatcagg 780
agataacgac gaggaggtag cagaggagct tgagttctca gatgatgaga aagaagcccg 840
aatacataaa aatgcagaag atggaaaaga gagggatgat ggatgaccaa aaagatggta 900
acgcaagaaa caagaagaag aaaaacaatg atctcggaac gtctacaagc aatgactcag 960
gggaatggac agagaaccgt gggtttagtt ctttatcctc caaccgttct gatcctcaaa 1020
tgggtgatcc ggtttcgaac catcagccac gacctcagat ggtgggtttt cctccaccgt 1080
ttggaggaaa atgatcaccg aaccgcgccg tgcgcgggtc gtcggtgagc cagagtttca 1140
gcaggccgcc caggcggccc aggtcgccat tgatgcgggc cagctcgcgg acgtgctcat 1200
agtccacgac gcccgtgatt ttgtagccct ggccgacggc cagcaggtag gccgacaggc 1260
tcatgccggc cgccgccgcc ttttcctcaa tcgctcttcg ttcgtctgga aggcagtaca 1320
ccttgatagg tgggctgccc ttcctggttg gcttggtttc atcagccatc cgcttgccct 1380
catctgttac gccggcggta gccggccagc ctcgcagagc aggattcccg ttgagcaccg 1440
ccaggtgcga ataagggaca gtgaagaagg aacacccgct cgcgggtggg cctacttcac 1500
ctatcctgcc cggctgacgc cgttggatac accaaggaaa gtctacacga accctttggc 1560
aaaatcctgt atatcgtgcg aaaaaggatg gatataccga 1600

<210> 233
<211> 3284
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 233
ccattaattt ccaccttcac ctacgatggg gggcatcgca ccggtgagta atattgtacg 60
gctaagagcg aatttggcct gtagacctca attgcgagct ttctaatttc aaactattcg 120
ggcctaactt ttggtgtgat gaaagtgtga gaatatttcc atattagaca attctgtaga 180
ttttatttaa tgaaagtgtg agaatatttt tttgtacact atttatcaat ttaataaaaa 240
aatataatat aatttaagat gaaccaacat atttctctaa attctgaatt ttattttcat 300
ggtgacacgt ggatacgaaa caatgttgta atgtttatcg attaatatat aatgtatgtt 360
atatgtttgt tgtactaaca acaagatttc atacatttca aacgaaaaag agagattgat 420

gtgatcagta ttattgcttt tacaaaacta ttgaaggttc agcgagttct tagtaaagtc 480
gaatccttgt aataatctct gttccaacgg gcaaacatgc agctgttaaa ctatcgacgc 540
cgtttgacct attttttctt cttctttgtt ttcttcctca tttgtacatg cgtgcaagcc 600
tactgacggt tggatgcctt ggcacgcact tcaacaactc tatatccttc ctggtgaggc 660
tatgtacgct tttaagcttc ttttcttgga cgcccttgag cttcttgctt ggaggtggga 720
gggtgagaag attagccctc ttgctagagc tttgttcgct cctgctgttg cttgtaagct 780
tggattctgg gctagattcg ttgctctccc tctctggctt caacctactg ttcacactgc 840
tttgtgtatc tgtgctactg tgtgtactgg tagcttctac ctcgccttct tcttctttat 900
ctctcacaac ttcgacggtg ttggtagcgt tggacctaag ggatcacttc ctagatcagc 960
tactttcgtt caacgtcagg ttgagactag ctctaacgtt ggtggttact ggcttggagt 1020
tcttaacggt ggacttaact ttcagataga gcaccacttg ttccctaggc ttcaccactc 1080
ttactacgct caaatagctc agtaaaatca actgtgtcca cattatcagt tttgtgtata 1140
cgatgaaata gggtaattca aaatctagct tgatatgcct tttggttcat tttaaccttc 1200
tgtaaacatt ttttcagatt ttgaacaagt aaatccaaaa aaaaaaaaaa aaatctcaac 1260
tcaacactaa attattttaa tgtataaaag atgcttaaaa catttggctt aaaagaaaga 1320
agctaaaaac atagagaact cttgtaaatt gaagtatgaa aatatactga attgggtatt 1380
atatgaattt ttctgattta ggattcacat gatccaaaaa ggaaatccag aagcactaat 1440
cagacattgg aagtaggatt aatcagtgat cagtaactat taaattcaat taaccgcgga 1500
catctacatt tttgaattga aaaaaaattg gtaattactc tttctttttc tccatattga 1560
ccatcatact cattgctgat ccatgtagat ttcccggaca tgaagccatc agtttccaat 1620
gaaccctcag ttccagatgc tgaacaacaa caggccacag tctccaatga acccacattt 1680
ccaaatgcaa ccgcagtttc ctatgaaccc tcagttccaa atgctgaaca ataacaggcc 1740
acagtctcaa gggtttaacg ctgggaagtc ttctgagcgg ggaaaggggc caccatggtc 1800
gtggcagaga tagttgtagg ggtcggtttg gacgtgggcg agggcaacag tgtggatgaa 1860
actgtatctg tgaagcattt tgatgtgtgt gaaaagcatg ttttatttgg ttttgtatgc 1920
caaatttttg tggtaaatta aattaactca gttatgatta ataatgaacg ccgttgccga 1980
gatcgaaccc gggtcacccg cgtgacaggc gggaatactt gccactatac tacaacgact 2040
ttgttgttaa cacaatttac aagtctaaac aaacctttaa gtagctgtta tatttggttt 2100
aaaaggcggg aacttacgta attagtggct ttcctttgaa gcaaacaccc aaaaaggtcc 2160
atcatctcca tgtcatcctc gtacgcttcg aactacacta aactgatcac tctcactaaa 2220
cagttaagct cttacgcgaa ccaaggaaac catgagcaag ctctcaacct ctttcgccaa 2280
atgcaatctt ctttcgcctt acctctcgac gcacacgtct tctcactcgc cctcaaatcc 2340
tgcgctgcag ccttccgtcc tgccctcggc gaatccatcc atgcccacac cctcaaatct 2400
aactttctct caaacccatt cgtgggatcc gctctactcg atatgtatgg taaatgcgtc 2460
tctgtttctc acgctcgcaa actgttcgac gaaattcccc agaggaacgc tgttgtctgg 2520
aacgcgatga tttcgcatta cacgcatcgt ggaaacatca gggaagctgt cgagttgtat 2580
gaggcgatgg atgttatgcc aaatgagtct tctttcaatg ctatcataaa gggtttagtg 2640
agtacagagg atgggtctta taaagcaatt ggattctata ggaagatggt tgagtttaga 2700
ttcaagccta ctttgattac tcttcttgcg ctagtatcag cttgttctgt catcggggcg 2760
tttcggttgg taaaagagat tcattcatat gcttttagga atctgattga gccgcacccg 2820
cagttgaaaa gcgggttggt agaggcgtat gggaggtgcg gaagcattga ttacgtgcaa 2880
ttggtgtttg agagcatggt tgatagggat gtggttgctt ggagtagctt ggtgtctgct 2940
tatgcgcttc acggtgacgc tgaatccgcc ctcagagcat ttcaagaaat ggaatctgct 3000
aaagtacgac ctgatgacat agcgtttctg aacgtgctga aggcctgtag tcacgctggg 3060
ttagctgatg aggctattgg ttactttaag aggatgcagg atggttacgg tttgagtgca 3120
agcaaggacc attactcgtg tttggtggat gttttaagca gagtggggag gtttgaagaa 3180
gcttacaaag tgattcaagc tatgcctgag aagccaacgg ctaagacatg gggggctctg 3240
cttggagcgt gtaggaacta cggggaggtt gagcttgcgg agat 3284

<210> 234
<211> 1700
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 234
attgatgtga tcagtattat tgcttttaca aaactattga aggttcagcg agttcttagt 60
aaagtcgaat ccttgtaata atctctgttc caacgggcaa acatgcagct gttaaactat 120
cgacgccgtt tgacctattt tttcttcttc tttgttttct tcctcatttg tattactatt 180
ttataagttt tgtgtagcgt tgtaaagctt tgacgctacg tagcgttacc taaggtcacg 240
tgagtctagg taggcttagc taatctcagg tgacgctacg tagccttacc taacgtcagg 300
tgaggctagc tagcgttagc taacctcacc tgacgctacg tagcgttacg taacgtcacg 360
tgagcctagg tagccttacg taacgtcagg tgacgctacg tagacaatca gtaaattgaa 420
cggagaatat tattcataaa aatacgatag taacgggtga tatattcatt agaatgaacc 480
gaaaccggcg gtaaggatct gagctacaca tgctcaggtt ttttacaacg tgcacaacag 540
aattgaaagc aaatatcatg cgatcatagg cgtctcgcat atctcattaa agcagcaatc 600

aattattcat taatcactac tcagccttac caccottctc agcaccaggt ctagttccca 660
tcttacccat atgctgaagc attgagctaa ggttagatcc aacggtaggg aagtgacggt 720
acttaaaacc gagcttctct atgtgagtcc taaccacagg agctatttga gcgtagtaag 780
agtggtgaag cctagggaac aagtggtgct ctatctgaaa gttaagtcca ccgttaagaa 840
ctccaagcca gtaaccacca acgttagagc tagtctcaac ctgacgttga acgaaagtag 900
ctgatctagg aagtgatccc ttaggtccaa cgctaccaac accgtcgaag ttgtgagaga 960
taaagaagaa gaaggcgagg tagaagctac cagtacacac agtagcacag atacacaaag 1020
cagtgtgaac agtaggttga agccagagag ggagagcaac gaatctagcc cagaatccaa 1080
gcttacaagc aacagcagga gcgaacaaag ctctagcaag agggctaatc ttctcaccct 1140
cccacctcca agcaagaagc tcaagggcgt ccaagaaaag aagcttaaaa gcgtacatag 1200
cctcaccagg aaggatatag agttgttgaa gtgcgtgcca aggcatccaa ccgtcagtag 1260
gctattctgt agattttatt taatgaaagt gtgagaatat ttagacaatt ctgtagattt 1320
tatttaatga aagtgtgaga atattttttt aaggcccgaa tagtttgaaa ttagaaagct 1380
cgcaattgag gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg 1440
atgcccccca tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac 1500
tattacgtaa gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga 1560
cgttacgtaa gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga 1620
cgttacgtaa cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt 1680
ctaaaccctt gtaatttgtt 1700

<210> 235
<211> 1532
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 235
gtggtaaggc tgagtagtga ttaatgaata attgattgct gctttaatga gatatgcgag 60
acgcctatga tcgcatgata tttgctttca attctgttgt gcacgttgta aaaaacctga 120
gcatgtgtag ctcagatcct taccgccggt ttcggttcat tctaatgaat atatcacccg 180
ttactatcgt atttttatga ataatattct ccgttcaatt tactgattgt ctacgtagcg 240
tcacctgacg ttacgtaagg ctacctaggc tcacgtgacg ttacgtaacg ctacgtagcg 300
tcaggtgagg ttagctaacg ctagctagcc tcacctgacg ttaggtaagg ctacgtagcg 360
tcacctgaga ttagctaagc ctacctagac tcacgtgacc ttaggtaacg ctacgtagcg 420
tcaaagcttt acaacgctac acaaaactgc ttgcgtttct tctctcatta cgagaatata 480
ctttttttcaa tattgcttca aaactttct gtcatgtgaa tttgatttta gatatatgtt 540
taaaaaatac ttcctccccg aaaataagat tttctaaagt gttcgattat taagaattca 600
ttaaatattt ataatttaat ttttctttta ctttattata cattttctaa taacttttta 660
ccaataaaat ttaatcaatt caaatatttt tatttaatgt ttcttaaaag tataaaaaat 720
atcttaatca tatagaaaat atatttttgt ggaacaagta aaaatctaaa acatcttact 780
ttcaggaacg gaggtaatag atagttacat taaaggtctc aacattacta ttttaagtct 840
attcacttgt tttgcttgct tgctaaccaa acaaagttta ctagtttaat taatatatta 900
ataaaaatat ccaatatatg accttgacca agacaaatgt gctagagtag tattaacggc 960
gtcagttgcc gttaatccca tttaccaaaa tatatatact acaagggaat ctcttctctc 1020
tctctcacca ttcaatcatt tccatctttt tcaaaatctc cttttcccac tctctctctc 1080
tctcgcttga agaacaagat tggtatattt gttacaacgg gctagtttat caatatcttt 1140
cacaaataaa gaagaagaag gtgatatctt tgaggttgat atctcgaaga aaatggggaa 1200
gaaagagcag aaagatcatc attcaacagt agaaagcgac gacaaagtcg aagctgttct 1260
tcatctcctt cgtaaacatt ctcctctcac tcttaaacag gtttgtttac gaattaatta 1320
tctcactgat ctttcattaa tctatcagct tttttttttt gaagtgctgg tttttatat 1380
tctcgggtta ataaatattg caggagaagt tctgtaacag agcttgtgtc agtagattct 1440
tgagaacaaa aggagacaat gcgaagaaag cagctaaaca gttaaggtca tgcctttcat 1500
ggagatcttc tcttggcatc ggtatactct tc 1532

<210> 236
<211> 1200
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 236
gtgacgttac gtaacgctac gtagcgtcag gtgaggttag ctaacgctag ctagcctcac 60
ctgacgttag gtaaggctac gtagcgtcac ctgagattag ctaagcctac ctagactcac 120
gtgaccttag gtaacgctac gtagcgtcaa agctttacaa cgctacacaa aaatgcttgc 180

gtttcttctc tcattacgag aatatacttt tttcaatatt gcttcaaaaa ctttctgtca 240
tgtgaatttg attttagata tatgtttaaa aaatacttcc tccccgaaaa taagattttc 300
taaagtgttc gattattaag aattcattaa atatttataa tttaattttt cttttacttt 360
attatacatt ttctaataac tttttaccaa taaaatttaa tcaattcaaa tatttttatt 420
taatgtttct taaaagtata aaaaatatct taatcatata gaaaatatat ttttgtggaa 480
caagtaaaaa tctaaaacat cttactttca ggaacggagg taatagatag ttacattaaa 540
ggtctcaaca ttactatttt aagtctattc acttgttttg cttgcttgct aaccaaacaa 600
agtttactag tttaattaat atattaataa aaatatccaa tatatgacct tgaccaagac 660
aaatgtgcta gagtagtatt aacggcgtca gttgccgtta atcccattta ccaaaatata 720
tatactacaa gggaatctct tctctctctc tcaccattca atcatttcca tctttttcaa 780
aatctccttt tcccactctc tctctctctc gcttgaagaa caagattggt atatttgtta 840
caacgggcta gtttatcaat atctttcaca aataaagaag aagaaggtga tatctttgag 900
gttgatatct cgaagaaaat ggggaagaaa gagcagaaag atcatcattc aacagtagaa 960
agcgacgaca aagtcgaagc tgttcttcat ctccttcgta aacattctcc tctcactctt 1020
aaacaggttt gtttacgaat taattatctc actgatcttt cattaatcta tcagcttttt 1080
ttttttgaag tgctggtttt ttatattctc gggttaataa atattgcagg agaagttctg 1140
taacagagct tgtgtcagta gattcttgag aacaaaagga gacaatgcga agaaagcagc 1200

<210> 237
<211> 1600
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 237
aaaagaaata taaaagaata tgaccaaaaa agtaaacgtg agtgagagaa taagaaaatg 60
actacaaaat ataatagcct caattatctt caaaactaag ttgacattta attatgcttt 120
tgcaagatat ttacttttgt tgttcgatca tatttaatga ttattttggt tttgaaacaa 180
atattaacat tatatatatt gtgtctatat tgaactgttg taaattataa acatcaaaat 240
tttaatgtta tcttaattat aatttctaat actagtatat tcaaaaatca aaataaacat 300
attttataaa atagtgccag tacgtagtat gggagataat actagtggct ttataaaggg 360
aaacattgtc tctaaaatct cagataaaat gttaaaacac acttattcac aattatgaag 420
atttgaaata tctgaaattt caaattgatg cacttggtag aaagcaaagg ttcaacgcta 480
agtctacaag gtgtaataat gaagtgaaaa tgctagttta gattaccctt gatatgtgac 540
tgaacatagg gtggagcgtc agtgagtcca tggagtacag aagctaaaca agagacatgg 600
ttaagcacca gaatcaactc gttctccata gagtccagct tttgagatat atgtgaatag 660
ccttgttgca atatacttgt gagtggcagg cgtgatctta ttaacgaaag tccaaattct 720
gaacaaagtt tatatcaagc tacgatggaa atatggaatc cgtatcaaaa tcaactgtac 780
tgtatcatac ggtgcagatt tttagctcga ctctaccacc ttgcgtttac ttttgtgatg 840
aacattgcga ttatatatga ggacctaaat agagggaaaa tgtatgaaga caggatccta 900
agaatgaaaa accagcatcc ccaagatgtg gcaccaagtg ctatcgacca caaactacgc 960
tggacatact ctgatatagt tcgttaagaa atcaaaatgt caacacatat aaataagcag 1020
tcagcatcat cacaccaaaa gttaggcccg aatagtttga aattagaaag ctcgcaattg 1080
aggtctacag gccaaattcg ctcttagccg tacaatatta ctcaccggtg cgatgccccc 1140
catcgtaggt gaaggtggaa attaatggcg cgcctgatca ctgattagta actattacgt 1200
aagcctacgt agcgtcacgt gacgttagct aacgctacgt agcctcagct gacgttacgt 1260
aagcctacgt agcgtcacgt gagcttagct aacgctacct aggctcagct gacgttacgt 1320
aacgctagct agcgtcactc ctgcagcaaa tttacacatt gccactaaac gtctaaaccc 1380
ttgtaatttg tttttgtttt actatgtgtg ttatgtattt gatttgcgat aaatttttat 1440
atttggtact aaatttataa caccttttat gctaacgttt gccaacactt agcaatttgc 1500
aagttgatta attgattcta aattattttt gtcttctaaa tacatatact aatcaactgg 1560
aaatgtaaat atttgctaat atttctacta taggagaatt 1600

<210> 238
<211> 1677
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 238
taattgaaat tcgttattag ggttctaagc tgttttaaca gtcactgggt taatatctct 60
cgaatcttgc atggaaaatg ctcttaccat tggtttttaa ttgaaatgtg ctcatatggg 120
ccgtggtttc caaattaaat aaaactacga tgtcatcgag aagtaaaatc aactgtgtcc 180
acattatcag ttttgtgtat acgatgaaat agggtaattc aaaatctagc ttgatatgcc 240

ttttggttca ttttaacctt ctgtaaacat tttttcagat tttgaacaag taaatccaaa 300
aaaaaaaaaa aaaatctcaa ctcaacacta aattatttta atgtataaaa gatgcttaaa 360
acatttggct taaaagaaag aagctaaaaa catagagaac tcttgtaaat tgaagtatga 420
aaatatactg aattgggtat tatatgaatt tttctgattt aggattcaca tgatccaaaa 480
aggaaatcca gaagcactaa tcagacattg gaagtaggat taatcagtga tcagtaacta 540
ttaaattcaa ttaaccgcgg acatctacat ttttgaattg aaaaaaaatt ggtaattact 600
ctttcttttt ctccatattg accatcatac tcattgtaag acacacagat gaagaagtca 660
aatagctcga cattcctttg gtctggtcca gtgatgtcga ctcacaaagc gaagattgca 720
tgaatagact atcatgtgtt tgctatgtat gagtactatg gaatcgaggg atcatttatt 780
tttcatgtca ttgttcttgg aggttgtgtg gagaggcatc accattaatc ttctgaacat 840
cagctatact aatcattaat tggaatcagc gactgcaaat tatggcagag gatgttggaa 900
atagtaccac cacattccta atccactatg ctttccaagc tgcagtaatt tgagttggag 960
acgggagttt tgctcattta ctcaggctct tggacaaaca aatgtgaaat cgcatatctg 1020
ctcaatccga catactaatc aaaggtcaag aatttttttt agagaagatg aaaaccataa 1080
tgaaagcatc taatgtttat agaaaattac caaaaatacc acatttatga aaaattatca 1140
aaaatacaat attcatagta tcacttttca tatttacaat aaccacgttt gttctcaatt 1200
ttaacgaaga acaaacgaca tttataatcc taagataatt ttttctaatt caaaaataat 1260
tttcgatttt caaaaaaaaa attgaaaaaa aaattgaaaa gaaaaattca aaacaaaatt 1320
atatgaaagt tcaaatttga aaaatgataa ttcaaaaaca taaaaaaata tatttttatt 1380
taaataatta tttattatat atatatagac catggagcaa gggggcgtgg gccccggggc 1440
ccaaactttt tttcccatat ataatgtcaa caaggacccg atttttagaa aaaaaaatag 1500
gtataaagga gtccaaaaaa ttcaaattag ttatatatgt atgtaaaaaa atattaaaat 1560
ttattttgcc caagggccta tagattcatt gggccgaccc tggggttggg gttgtgtgtg 1620
tgtcattcta taattaaccg gcaaaaactc caaaattttt atttaacaaa tgtataa 1677

<210> 239
<211> 5600
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 239
attttagatt tagtcatatt tttaacttaa ttattaatta taataaatat ttttagtgat 60
ttagatgata aattttcatt gtcttgagaa taataaaaaa aaaatctaag gataatatca 120
tagttaaatt tatatgatat ttacttcagt aatattaaaa tattatatac atttttatta 180
tatttggttt agtaatatta aatggattct attttaaatt tcttatgaca atcaaaacca 240
cttagtgtga taatttctga aaaaaattgg caaaaaaatc aaaaatactt atcttattat 300
ttgtagtgat ttttctctct ctcatgttaa aattttgaat gtttaaagtc tttattatct 360
ttaataaata attagattaa atttttaata tataattacc cataatttaa aacaaatttc 420
attaatttta aaatcatcat tatctaaaaa gattatatat tatgttatcc aaaaatattt 480
tacatcataa tattttaaaa taaatataaa tttatgtata ttgttttatg tatatatgaa 540
tgtttttaag tttattttac ataatcaaat atattttaca aaaataattt ttatcatata 600
taaaatttaa catttaatta attattaaat atttcaaaag tatgaatata acttattctc 660
atggttttta attgataata tatctattta caatttttttg taaaattatt aaacccgcaa 720
gtatggacaa aacacctagt atatatattt ggaacaaaga atacagacaa aacacctagt 780
atatatattt ggaacaaaaa atatacgtac atattttata tacatgaata acttatatat 840
cacttagaaa taggataatc aattgacatt aaactctctt aaattatata ttgtatagaa 900
ctatagatat acgtataaaa tatttataaa agataactac actatatata gaaacagata 960
atgatacatc cacgaaaatt cttctggaaa agaaacagag tggtttcgcg tcagcacacc 1020
tacgttgatc attggaaatt ggaatattga aacacgcttc aaatcaacga ctattaatta 1080
ccaatacacc ctggctttgg ggtgagagtt gatcggttaa ttatccaata catgccgttg 1140
gttaattagg attatataaa aaatcgatca tctattagaa tcgattacgg ttaaataggt 1200
ataaaaatgg agagaattga atcagttata aatttgtttt cagttaaaat atttctatga 1260
tcttcaatcg atttcggtat tttatactca acatggaaaa aatttcaaat gtatttcttc 1320
taaaagcaaa agaatctata aaaactatca ttttatccaa aacaccaaaa tagtctttta 1380
caatctttta cagccttcac ataaacgaaa acaaaagtga acaatttctt tttacagcct 1440
ttacaccaaa aagactacga tgaactatga taaaatttca taatctaaaa acattaatga 1500
ggtaaagact ctctcaaatg ggatattctt cgaaaatttt cataatcgaa cgatatactt 1560
gaatttgcaa ctcatgaccg aaattgtccc aatccataat actctttgac accctatcag 1620
atcccaacgt tgtccctggt ttcgaaacca ccatttcaaa catgaacata tcacaaaata 1680
aacatttaga caccaaatat ctgctaagcg cttacgtaag ctcagctgac gctacctagc 1740
gttagctaac gtcacgtgac gctacctagc gttacgtaac gtcagctgag gctagctagc 1800
tgaattaacg ccgaattaat tcgggggatc tggattttag tactggattt tggttttagg 1860
aattagaaat tttattgata gaagtatttt acaaatacaa atacatacta agggtttctt 1920
atatgctcaa cacatgagcg aaaccctata ggaaccctaa ttcccttatc tgggaactac 1980
tcacacatta ttatggagaa actcgagctt gtcgatcact cggtcttagc tcccttttgc 2040

tttccatcgg atggcttgat gtacttttgc acgtagaagt ttccgaagag gaacaagagg 2100
gagatcatgt agtagaagag gatcttgatg agccattgtg gatatggagc gttggttttc 2160
atatcgtagt aagcttgcac caagttgagc atgaactgga acatctggaa ttgggtgagg 2220
tatcttcccc agaagaggta cttgttcttg agctttgggg aagatctcaa gcaagcagcc 2280
aagaagtagt aagcgtacat caacacgtgc actccagagt tgagagcagc actccaataa 2340
gcctctcctc ctggagcgtg gtgagcaata gcccaccaga taagggagat agaagagtgg 2400
tggtacacgt ggaggaaaga aatctgtctg gtggatctct tgaggatcat gatcacggta 2460
tccatgaact ccacgtactt ggacatgtag aagaggtaaa cgaggatagc catctccttg 2520
tgctttgggt tataagcgtt tccccacaag gaatatctcc aggtgatagc ttggtaagcg 2580
atacccacgc acatgtaaag agacaaagcg aagcagaaca agttgtgcac caacaccaaa 2640
gcttgcaaca agaatggctc agaagctctt ggcttgagat ctctagcctt gatccaaagc 2700
aatcctccga tcacgatggt caagtaaaca gacactccca acacaattgg agttggagaa 2760
tcaacgagtg gcaatccctt agtagttggg gtatcagtca actcaactcc gaaagatccc 2820
aacaaagcgt tcactccttg ggaaaccttt ccatccaact ctccgtagaa cctctcaaca 2880
acttccatgg tttcttctaa agctgaaagt gaaccattat tacaacttaa cactcaactc 2940
acaagaggag aagcaacaaa gcttatgtaa ggatttagta ttaaggccaa aaaaacacag 3000
atcaaattca attattgaag ctttacttat caagttatca tataaccaat gaagacggta 3060
attcaaaaga aaaataaaag ggtttgtaga ataattgata cgtttacctt tgccgattca 3120
gagacagtga agcttaaaca gtactggcta tgaagaaatt ataatcgtgt aaaacttagt 3180
gagtgtgtat gaatgaaagt attgcaaaat cctcattata tagactacat gcataactag 3240
ttgcatgtaa atttgtagtt ttcttcatta ttgcatcctc caagtggatg tcatggtttt 3300
acacatggct tccatgcaaa tcatttccaa aatattttta aactttccac agggcatcca 3360
tgcatgcacc tcaaaacttg tgtgtggtaa cattgttgtc ttgaaaaatt actaaacctt 3420
ttgtccacgt gacgttcatg cacctcaaat cttgtgtggt accattatta tcctcaagaa 3480
ttattgaatg tttggtgtat atgccatcca tgcagcattg caacaattaa atctccaaac 3540
cttgtggtac catattcact cactttaatt ctcctatagt agaaatatta gcaaatattt 3600
acatttccag ttgattagta tatgtattta gaagacaaaa ataatttaga atcaattaat 3660
caacttgcaa attgctaagt gttggcaaac gttagcataa aaggtgttat aaatttagta 3720
ccaaatataa aaatttatcg caaatcaaat acataacaca catagtaaaa caaaaacaaa 3780
ttacaagggt ttagacgttt agtggcaatg tgtaaatttg ctgcaggagt gacgctagct 3840
agcgttacgt aacgtcagct gagcctaggt agcgttagct aagctcacgt gacgctacgt 3900
aggcttacgt aacgtcagct gaggctacgt agcgttagct aacgtcacgt gacgctacgt 3960
aggcttacgt aatagttact aatcagtgat caggcgcgcc attaatttcc accttcacct 4020
acgatggggg gcatcgcacc ggtgagtaat attgtacggc taagagcgaa tttggcctgt 4080
agacctcaat tgcgagcttt ctaatttcaa actattcggg cctaactttt ggtgtgatga 4140
tgctgactgt ttcgacgtta attgatccta cactatgtag gtcatatcca tcgttttaat 4200
ttttggccac cattcaattc tgtcttgcct ttagggatgt gaatatgaac ggccaaggta 4260
agagaataaa aataatccaa attaaagcaa gagaggccaa gtaagataat ccaaatgtac 4320
acttgtcatt gccaaaatta gtaaaatact cggcatattg tattcccaca cattattaaa 4380
ataccgtata tgtattggct gcatttgcat gaataatact acgtgtaagc ccaaaagaac 4440
ccacgtgtag cccatgcaaa gttaacactc acgaccccat tcctcagtct ccactatata 4500
aacccaccat ccccaatctc accaaaccca ccacacaact cacaactcac tctcacacct 4560
taaagaacca atcaccacca aaaaatttca cgatttggaa tttgattcct gcgatcacag 4620
gtatgacagg ttagattttg ttttgtatag ttgtatacat acttctttgt gatgttttgt 4680
ttacttaatc gaatttttgg agtgttttaa ggtctctcgt ttagaaatcg tggaaaatat 4740
cactgtgtgt gtgttcttat gattcacagt gtttatgggt ttcatgttct ttgttttatc 4800
attgaatggg aagaaatttc gttgggatac aaatttctca tgttcttact gatcgttatt 4860
aggagtttgg ggaaaaagga agagtttttt tggttggttc gagtgattat gaggttattt 4920
ctgtatttga tttatgagtt aatggtcgtt ttaatgttgt agacatggga aaaggatctg 4980
agggaagatc tgctgctaga gagatgactg ctgaggctaa cggagataag agaaagacca 5040
tcctcattga gggagtgttg tacgatgcta ccaacttcaa acacccagga ggttccatta 5100
ttaacttcct caccgaggga gaagctggag ttgatgctac ccaagcttac agagagttcc 5160
atcagagatc cggaaaggct gataagtacc tcaagtccct cccaaagttg gatgcttcta 5220
aggtggagtc taggttctct gctaaggagc aggctagaag ggacgctatg accagggatt 5280
acgctgcttt cagagaggag ttggttgctg agggatactt cgatccatct atcccacaca 5340
tgatctacag agtggtggag attgtggctt tgttcgcttt gtctttctgg ttgatgtcta 5400
aggcttctcc aacctctttg gttttgggag tggtgatgaa cggaatcgct caaggaagat 5460
gcggatgggt tatgcacgag atgggacacg gatctttcac tggagttatc tggctcgatg 5520
ataggatgtg cgagttcttc tacggagttg gatgtggaat gtctggacac tactggaaga 5580
accagcactc taagcaccac 5600

<210> 240
<211> 1321
<212> DNA
<213> Artificial Sequence

<220>
<223> flanking sequence

<400> 240
taaagatata ttaggcaatg agtttatgat gttatgttta tatagtttat ttcattttaa 60
attgaaaagc attattttta tcgaaatgaa tctagtatac aatcaatatt tatgtttttt 120
catcagatac tttcctattt tttggcacct ttcatcggac tactgattta tttcaatgtg 180
tatgcatgca tgagcatgag tatacacatg tcttttaaaa tgcatgtaaa gcgtaacgga 240
ccacaaaaga ggatccatac aaatacatct catcgcttcc tctactattc tccgacacac 300
acactgagca tggtgcttaa acactctggt gagttctagt acttctgcta taatgttaaa 360
ttttatatta tatacctact tcctctctct cgctctgtta tgttcgattt cgaaaggatt 420
tcaagatcaa agatgatgag aaaaggtacc ttttcgatat ttaagacaag gaaagaaagg 480
acgaggttga aattttcggg acttggaggg ctaaagtgga agagactgaa tctgaagatg 540
tcgtttctcg aaactttgag atacagaatc atgtctatca ttgaaggaat ggttttggtt 600
tctaagcttg ctttcttctt tctctgttgc ggttgcagat tttaacacgt tagttttttt 660
tttttcgttt ttttgaacgt caacaatgtc ttttttgtac tctttagctc atgtgtaaaa 720
ttctaaattc ttccaataac atacccaaca aattattcgt atctgatttt tatagttttt 780
aacctgttaa tgtaattaat ctaagtgtaa tttttaggct aaatgttaaa ttttatatta 840
aagttttgta acttgaaatt acattcttct tatagcggat aaacagaaaa tgctcttaaa 900
caaatcctga aacaagtaaa aaatacaaca gaaaaatcta acgtttaatt cttaaaacct 960
caaaatcctt atttttacag ctttcaaagt ttaacagctg gaaacctgta gaaaatcaga 1020
cacagcctct caagttttct ggacaataaa tactggtaac gtaagaaaac caattaatga 1080
taccgtcgtt cagtagatag aactgacgat gtgaagatta attgtttctg taatatactg 1140
aatttgaaaa tttatcatca tcatgttaac ggaagttgtc tgtaaaagta gttgattacc 1200
tgttatcgtg taaagtagtt agtaatttct tgcttatttg aaaaatagag aacatttaac 1260
atgtattttt aaataggcac gaccatgcta ctgaacttta tgaaatgctt tggaatctta 1320
t 1321

<210> 241
<211> 100
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 241
aagacgtccg caatgtgtta ttaagttgtc taagcgtcaa tttgttgtcg gcaagatctc 60
tgacactcaa ctaaaatgtt ggattttccc tttcaggtgt 100

<210> 242
<211> 148
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 242
cacacacctc cccaatccat ggatatgttc tctcttttct caatcaattt gtttacactc 60
aaacactgat agtttaaact gaaggcggga aacgacaatc tgatcactga ttagtaacta 120
aggcctttaa ttaatctaga ggcgcgcc 148

<210> 243
<211> 147
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 243
ggcgcgcctc tagattaatt aaaggcctta gttactaatc agtgatcaga ttgtcgtttc 60
ccgccttcag tttaaactat cagtgttgct ttagtggtca atcaaaagat gaacagtatc 120
ttctcgatcg atgatttctc cgatccc 147

<210> 244
<211> 118
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 244
caccaaaagc aaccaagaga gacgtcttta atgtactgaa tttagtaact gaaggcggga 60
aacgacaatc tgatcactga ttagtaacta aggcctttaa ttaatctaga ggcgcgcc 118

<210> 245
<211> 110
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 245
gcggacatct acatttttga attgaaaaaa aattggtaat tactctttct ttttctccat 60
attgaccatc atactcattg taagacacac agatgaagaa gtcaaatagc 110

<210> 246
<211> 95
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 246
cactgagcat ggtgcttaaa cactctggtg agttctagta cttctgctat aatgttaaat 60
tttatattat atacctactt cctctctctc gctct 95

<210> 247
<211> 101
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 247
ctctttcttt ttctccatat tgaccatcat actcattgct gatccatgta gatttcccgg 60
acatgaagcc atttgtcaac gtcgttgttt gatttcgtta a 101

<210> 248
<211> 197
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 248
caattaaccg cggacatcta cattttttta ctgctattct ttcatattag caactggttg 60
attactgaat tagtacagat gtaactaaca tatatattgg atattattat tatccaaaag 120
agctattcaa ccttttaagc atatgtatat acatgtttaa ttgattttat tagtatttct 180
tgctcttgtt gttttgc 197

<210> 249
<211> 138
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 249
aattaaccgc ggacatctac atttttgaat tgaaaaaaaa ttggtaatta ctctttcttt 60

ttctccatat tgaccatcat actcattgct gatccatgta gatttcccgg ttctttttct 120
cagactactc actgcccg 138

<210> 250
<211> 137
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 250
ctctttcttt ttctccatat tgaccatcat actcattgct gatccatgta gatttcccgg 60
acatgaagcc atttacaatc catgtcctta taaatggttt atatactctt ataaataatt 120
tgcttcttca tgcctca 137

<210> 251
<211> 113
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 251
ctctttcttt ttctccatat tgaccatcat actcattgct gatccatgta gatttcccgg 60
acatgaagcc atttacaatg agtcaaaaaa aagttgtttt gatgagtcac tgc 113

<210> 252
<211> 160
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 252
ctctttcttt ttctccatat tgaccatcat actcattgct gatccatgta gatttcccgg 60
acatgaagcc atttactctg accctactcc acaaatatat ttttatttat aaaaaggtgg 120
ccattgtata ctatgtgtgc gtatacagga ataaaaatgt 160

<210> 253
<211> 169
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 253
ccatattgac catcatactc attgctgatc catgtagatt tcccggacat gaagccattt 60
acaattgaat atatcctcac atatgaaata tatttttttt ttacaaatta cacctattaa 120
attatacttg atcggtcatc tgatatattt gaaagaaccc tatcagcca 169

<210> 254
<211> 576
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 254
gacctcaatt gcgagctttc taatttcaaa ctattcgggc ctaacttttg gtgtgatgaa 60
agtgtgagaa tatttccata ttagacaatt ctgtagattt tatttaatga aagtgtgaga 120
atattttttt gtacactatt tatcaattta ataaaaaaat ataatataat ttaagatgaa 180
ccaacatatt tctctaaatt ctgaatttta ttttcatggt gacacgtgga tacgaaacaa 240
tgttgtaatg tttatcgatt aatatataat gtatgttata tgtttgttgt actaacaaca 300

agatttcata catttcaaac gaaaaagaga gattgatgtg atcagtatta ttgcttttac 360
aaaactattg aaggttcagc gagttcttag taaagtcgaa tccttgtaat aatctctgtt 420
ccaacgggca aacatgcagc tgttaaacta tcgacgccgt ttgacctatt ttttcttctt 480
ctttgttttc ttcctcattt gtacatgcgt gcaagcctac tgacggttgg atgccttggc 540
acgcacttca acaactctat atccttcctg gtgagg 576

<210> 255
<211> 189
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 255
cgtgccaagg catccaaccg tcagtaggct attctgtaga ttttatttaa tgaaagtgtg 60
agaatattta gacaattctg tagattttat ttaatgaaag tgtgagaata tttttttaag 120
gcccgaatag tttgaaatta gaaagctcgc aattgaggtc tacaggccaa attcgctctt 180
agccgtaca 189

<210> 256
<211> 91
<212> DNA
<213> Artificial Sequence

<220>
<223> amplicon

<400> 256
gcctacctag actcacgtga ccttaggtaa cgctacgtag cgtcaaagct ttacaacgct 60
acacaaaaat gcttgcgttt cttctctcat t 91

<210> 257
<211> 873
<212> DNA
<213> Artificial Sequence

<220>
<223> d6Elo(Pp) as by plasmid VC-LTM593-1qcz

<400> 257
atggaagttg ttgagaggtt ctacggagag ttggatggaa aggtttccca aggagtgaac 60
gctttgttgg gatctttcgg agttgagttg actgataccc caactactaa gggattgcca 120
ctcgttgatt ctccaactcc aattgtgttg ggagtgtctg tttacttgac catcgtgatc 180
ggaggattgc tttggatcaa ggctagagat ctcaagccaa gagcttctga gccattcttg 240
ttgcaagctt tggtgttggt gcacaacttg ttctgcttcg ctttgtctct ttacatgtgc 300
gtgggtatcg cttaccaagc tatcacctgg agatattcct tgtggggaaa cgcttataac 360
ccaaagcaca aggagatggc tatcctcgtt tacctcttct acatgtccaa gtacgtggag 420
ttcatggata ccgtgatcat gatcctcaag agatccacca gacagatttc tttcctccac 480
gtgtaccacc actcttctat ctcccttatc tggtgggcta ttgctcacca cgctccagga 540
ggagaggctt attggagtgc tgctctcaac tctggagtgc acgtgttgat gtacgcttac 600
tacttcttgg ctgcttgctt gagatcttcc ccaaagctca agaacaagta cctcttctgg 660
ggaagatacc tcacccaatt ccagatgttc cagttcatgc tcaacttggt gcaagcttac 720
tacgatatga aaaccaacgc tccatatcca caatggctca tcaagatcct cttctactac 780
atgatctccc tcttgttcct cttcggaaac ttctacgtgc aaaagtacat caagccatcc 840
gatggaaagc aaaagggagc taagaccgag tga 873

<210> 258
<211> 290
<212> PRT
<213> Physcomitrella patens

<220>
<223> d6Elo(Pp) as by plasmid VC-LTM593-1qcz

<400> 258
Met Glu Val Val Glu Arg Phe Tyr Gly Glu Leu Asp Gly Lys Val Ser
1 5 10 15

```
Gln Gly Val Asn Ala Leu Leu Gly Ser Phe Gly Val Glu Leu Thr Asp
            20                  25                  30
Thr Pro Thr Thr Lys Gly Leu Pro Leu Val Asp Ser Pro Thr Pro Ile
        35                  40                  45
Val Leu Gly Val Ser Val Tyr Leu Thr Ile Val Ile Gly Gly Leu Leu
    50                  55                  60
Trp Ile Lys Ala Arg Asp Leu Lys Pro Arg Ala Ser Glu Pro Phe Leu
65                  70                  75                  80
Leu Gln Ala Leu Val Leu Val His Asn Leu Phe Cys Phe Ala Leu Ser
                85                  90                  95
Leu Tyr Met Cys Val Gly Ile Ala Tyr Gln Ala Ile Thr Trp Arg Tyr
            100                 105                 110
Ser Leu Trp Gly Asn Ala Tyr Asn Pro Lys His Lys Glu Met Ala Ile
        115                 120                 125
Leu Val Tyr Leu Phe Tyr Met Ser Lys Tyr Val Glu Phe Met Asp Thr
    130                 135                 140
Val Ile Met Ile Leu Lys Arg Ser Thr Arg Gln Ile Ser Phe Leu His
145                 150                 155                 160
Val Tyr His His Ser Ser Ile Ser Leu Ile Trp Trp Ala Ile Ala His
                165                 170                 175
His Ala Pro Gly Gly Glu Ala Tyr Trp Ser Ala Ala Leu Asn Ser Gly
            180                 185                 190
Val His Val Leu Met Tyr Ala Tyr Tyr Phe Leu Ala Ala Cys Leu Arg
        195                 200                 205
Ser Ser Pro Lys Leu Lys Asn Lys Tyr Leu Phe Trp Gly Arg Tyr Leu
    210                 215                 220
Thr Gln Phe Gln Met Phe Gln Phe Met Leu Asn Leu Val Gln Ala Tyr
225                 230                 235                 240
Tyr Asp Met Lys Thr Asn Ala Pro Tyr Pro Gln Trp Leu Ile Lys Ile
                245                 250                 255
Leu Phe Tyr Tyr Met Ile Ser Leu Leu Phe Leu Phe Gly Asn Phe Tyr
            260                 265                 270
Val Gln Lys Tyr Ile Lys Pro Ser Asp Gly Lys Gln Lys Gly Ala Lys
        275                 280                 285
Thr Glu
    290
```

<210> 259
<211> 1320
<212> DNA
<213> Artificial Sequence

<220>
<223> d5Des(Tc) as by plasmid VC-LTM593-1qcz

<400> 259

```
atgggaaaag gatctgaggg aagatctgct gctagagaga tgactgctga ggctaacgga      60
gataagagaa agaccatcct cattgaggga gtgttgtacg atgctaccaa cttcaaacac     120
ccaggaggtt ccattattaa cttcctcacc gagggagaag ctggagttga tgctacccaa     180
gcttacagag agttccatca gagatccgga aaggctgata agtacctcaa gtccctccca     240
aagttggatg cttctaaggt ggagtctagg ttctctgcta aggagcaggc tagaagggac     300
gctatgacca gggattacgc tgctttcaga gaggagttgg ttgctgaggg atacttcgat     360
ccatctatcc cacacatgat ctacagagtg gtggagattg tggctttgtt cgctttgtct     420
ttctggttga tgtctaaggc ttctccaacc tctttggttt tgggagtggt gatgaacgga     480
atcgctcaag gaagatgcgg atgggttatg cacgagatgg gacacggatc tttcactgga     540
gttatctggc tcgatgatag gatgtgcgag ttcttctacg gagttggatg tggaatgtct     600
ggacactact ggaagaacca gcactctaag caccacgctg ctccaaacag attggagcac     660
gatgtggatt tgaacacctt gccactcgtt gctttcaacg agagagttgt gaggaaggtt     720
aagccaggat ctttgttggc tttgtggctc agagttcagg cttatttgtt cgctccagtg     780
tcttgcttgt tgatcggatt gggatggacc ttgtacttgc acccaagata tatgctcagg     840
accaagagac acatggagtt tgtgtggatc ttcgctagat atatcggatg gttctccttg     900
atgggagctt tgggatattc tcctggaact tctgtgggaa tgtacctctg ctctttcgga     960
cttggatgca tctacatctt cctccaattc gctgtgtctc acacccactt gccagttacc    1020
aacccagagg atcaattgca ctggcttgag tacgctgctg atcacaccgt gaacatctct    1080
accaagtctt ggttggttac ctggtggatg tctaacctca acttccaaat cgagcaccac    1140
ttgttcccaa ccgctccaca attcaggttc aaggagatct ctccaagagt tgaggctctc    1200
ttcaagagac acaacctccc ttactacgat ttgccataca cctctgctgt ttctactacc    1260
ttcgctaacc tctactctgt tggacactct gttggagctg ataccaagaa gcaggattga    1320
```

<210> 260
<211> 439
<212> PRT
<213> Thraustochytrium sp.

<220>
<223> d5Des(Tc) as by plasmid VC-LTM593-1qcz

<400> 260
Met Gly Lys Gly Ser Glu Gly Arg Ser Ala Ala Arg Glu Met Thr Ala
1   5   10   15
Glu Ala Asn Gly Asp Lys Arg Lys Thr Ile Leu Ile Glu Gly Val Leu
            20   25   30
Tyr Asp Ala Thr Asn Phe Lys His Pro Gly Gly Ser Ile Ile Asn Phe
        35   40   45
Leu Thr Glu Gly Glu Ala Gly Val Asp Ala Thr Gln Ala Tyr Arg Glu
    50   55   60
Phe His Gln Arg Ser Gly Lys Ala Asp Lys Tyr Leu Lys Ser Leu Pro
65   70   75   80
Lys Leu Asp Ala Ser Lys Val Glu Ser Arg Phe Ser Ala Lys Glu Gln
                85   90   95
Ala Arg Arg Asp Ala Met Thr Arg Asp Tyr Ala Ala Phe Arg Glu Glu
            100   105   110
Leu Val Ala Glu Gly Tyr Phe Asp Pro Ser Ile Pro His Met Ile Tyr
        115   120   125
Arg Val Val Glu Ile Val Ala Leu Phe Ala Leu Ser Phe Trp Leu Met
    130   135   140
Ser Lys Ala Ser Pro Thr Ser Leu Val Leu Gly Val Val Met Asn Gly
145   150   155   160
Ile Ala Gln Gly Arg Cys Gly Trp Val Met His Glu Met Gly His Gly
                165   170   175
Ser Phe Thr Gly Val Ile Trp Leu Asp Asp Arg Met Cys Glu Phe Phe
            180   185   190
Tyr Gly Val Gly Cys Gly Met Ser Gly His Tyr Trp Lys Asn Gln His
        195   200   205
Ser Lys His His Ala Ala Pro Asn Arg Leu Glu His Asp Val Asp Leu
    210   215   220
Asn Thr Leu Pro Leu Val Ala Phe Asn Glu Arg Val Val Arg Lys Val
225   230   235   240
Lys Pro Gly Ser Leu Leu Ala Leu Trp Leu Arg Val Gln Ala Tyr Leu
                245   250   255
Phe Ala Pro Val Ser Cys Leu Leu Ile Gly Leu Gly Trp Thr Leu Tyr
            260   265   270
Leu His Pro Arg Tyr Met Leu Arg Thr Lys Arg His Met Glu Phe Val
        275   280   285
Trp Ile Phe Ala Arg Tyr Ile Gly Trp Phe Ser Leu Met Gly Ala Leu
    290   295   300
Gly Tyr Ser Pro Gly Thr Ser Val Gly Met Tyr Leu Cys Ser Phe Gly
305   310   315   320
Leu Gly Cys Ile Tyr Ile Phe Leu Gln Phe Ala Val Ser His Thr His
                325   330   335
Leu Pro Val Thr Asn Pro Glu Asp Gln Leu His Trp Leu Glu Tyr Ala
            340   345   350
Ala Asp His Thr Val Asn Ile Ser Thr Lys Ser Trp Leu Val Thr Trp
        355   360   365
Trp Met Ser Asn Leu Asn Phe Gln Ile Glu His His Leu Phe Pro Thr
    370   375   380
Ala Pro Gln Phe Arg Phe Lys Glu Ile Ser Pro Arg Val Glu Ala Leu
385   390   395   400
Phe Lys Arg His Asn Leu Pro Tyr Tyr Asp Leu Pro Tyr Thr Ser Ala
                405   410   415
Val Ser Thr Thr Phe Ala Asn Leu Tyr Ser Val Gly His Ser Val Gly
            420   425   430
Ala Asp Thr Lys Lys Gln Asp
        435

<210> 261

<211> 1371
<212> DNA
<213> Artificial Sequence

<220>
<223> d6Des(Ot) as by plasmid VC-LTM593-1qcz

<400> 261
```
atgtgtgttg agaccgagaa caacgatgga atccctactg tggagatcgc tttcgatgga      60
gagagagaaa gagctgaggc taacgtgaag ttgtctgctg agaagatgga acctgctgct     120
ttggctaaga ccttcgctag aagatacgtg gttatcgagg gagttgagta cgatgtgacc     180
gatttcaaac atcctggagg aaccgtgatt ttctacgctc tctctaacac tggagctgat     240
gctactgagg ctttcaagga gttccaccac agatctagaa aggctaggaa ggctttggct     300
gctttgcctt ctagacctgc taagaccgct aaagtggatg atgctgagat gctccaggat     360
ttcgctaagt ggagaaagga gttggagagg gacggattct tcaagccttc tcctgctcat     420
gttgcttaca gattcgctga gttggctgct atgtacgctt tgggaaccta cttgatgtac     480
gctagatacg ttgtgtcctc tgtgttggtt tacgcttgct tcttcggagc tagatgtgga     540
tgggttcaac acgagggagg acactcttct ttgaccggaa acatctggtg ggataagaga     600
atccaagctt tcactgctgg attcggattg gctggatctg gagatatgtg gaactccatg     660
cacaacaagc accacgctac tcctcaaaaa gtgaggcacg atatggattt ggataccact     720
cctgctgttg ctttcttcaa caccgctgtg gaggataata gacctagggg attctctaag     780
tactggctca gattgcaagc ttggaccttc attcctgtga cttctggatt ggtgttgctc     840
ttctggatgt tcttcctcca cccttctaag gctttgaagg gaggaaagta cgaggagctt     900
gtgtggatgt tggctgctca cgtgattaga acctggacca ttaaggctgt tactggattc     960
accgctatgc aatcctacgg actcttcttg gctacttctt gggtttccgg atgctacttg    1020
ttcgctcact tctctacttc tcacacccac ttggatgttg ttcctgctga tgagcacttg    1080
tcttgggtta ggtacgctgt ggatcacacc attgatatcg atccttctca gggatgggtt    1140
aactggttga tgggatactt gaactgccaa gtgattcacc acctcttccc ttctatgcct    1200
caattcagac aacctgaggt gtccagaaga ttcgttgctt tcgctaagaa gtggaacctc    1260
aactacaagg tgatgactta tgctggagct tggaaggcta ctttgggaaa cctcgataat    1320
gtgggaaagc actactacgt gcacggacaa cactctggaa agaccgcttg a             1371
```

<210> 262
<211> 456
<212> PRT
<213> Ostreococcus tauri

<220>
<223> d6Des(Ot) as by plasmid VC-LTM593-1qcz

<400> 262
```
Met Cys Val Glu Thr Glu Asn Asn Asp Gly Ile Pro Thr Val Glu Ile
1               5                   10                  15
Ala Phe Asp Gly Glu Arg Glu Arg Ala Glu Ala Asn Val Lys Leu Ser
            20                  25                  30
Ala Glu Lys Met Glu Pro Ala Ala Leu Ala Lys Thr Phe Ala Arg Arg
        35                  40                  45
Tyr Val Val Ile Glu Gly Val Glu Tyr Asp Val Thr Asp Phe Lys His
    50                  55                  60
Pro Gly Gly Thr Val Ile Phe Tyr Ala Leu Ser Asn Thr Gly Ala Asp
65                  70                  75                  80
Ala Thr Glu Ala Phe Lys Glu Phe His His Arg Ser Arg Lys Ala Arg
                85                  90                  95
Lys Ala Leu Ala Ala Leu Pro Ser Arg Pro Ala Lys Thr Ala Lys Val
            100                 105                 110
Asp Asp Ala Glu Met Leu Gln Asp Phe Ala Lys Trp Arg Lys Glu Leu
        115                 120                 125
Glu Arg Asp Gly Phe Phe Lys Pro Ser Pro Ala His Val Ala Tyr Arg
    130                 135                 140
Phe Ala Glu Leu Ala Ala Met Tyr Ala Leu Gly Thr Tyr Leu Met Tyr
145                 150                 155                 160
Ala Arg Tyr Val Val Ser Ser Val Leu Val Tyr Ala Cys Phe Phe Gly
                165                 170                 175
Ala Arg Cys Gly Trp Val Gln His Glu Gly Gly His Ser Ser Leu Thr
            180                 185                 190
Gly Asn Ile Trp Trp Asp Lys Arg Ile Gln Ala Phe Thr Ala Gly Phe
        195                 200                 205
Gly Leu Ala Gly Ser Gly Asp Met Trp Asn Ser Met His Asn Lys His
```

```
    210                 215                 220
His Ala Thr Pro Gln Lys Val Arg His Asp Met Asp Leu Asp Thr Thr
225                 230                 235                 240
Pro Ala Val Ala Phe Phe Asn Thr Ala Val Glu Asp Asn Arg Pro Arg
                245                 250                 255
Gly Phe Ser Lys Tyr Trp Leu Arg Leu Gln Ala Trp Thr Phe Ile Pro
            260                 265                 270
Val Thr Ser Gly Leu Val Leu Leu Phe Trp Met Phe Phe Leu His Pro
        275                 280                 285
Ser Lys Ala Leu Lys Gly Gly Lys Tyr Glu Glu Leu Val Trp Met Leu
    290                 295                 300
Ala Ala His Val Ile Arg Thr Trp Thr Ile Lys Ala Val Thr Gly Phe
305                 310                 315                 320
Thr Ala Met Gln Ser Tyr Gly Leu Phe Leu Ala Thr Ser Trp Val Ser
                325                 330                 335
Gly Cys Tyr Leu Phe Ala His Phe Ser Thr Ser His Thr His Leu Asp
            340                 345                 350
Val Val Pro Ala Asp Glu His Leu Ser Trp Val Arg Tyr Ala Val Asp
        355                 360                 365
His Thr Ile Asp Ile Asp Pro Ser Gln Gly Trp Val Asn Trp Leu Met
    370                 375                 380
Gly Tyr Leu Asn Cys Gln Val Ile His His Leu Phe Pro Ser Met Pro
385                 390                 395                 400
Gln Phe Arg Gln Pro Glu Val Ser Arg Arg Phe Val Ala Phe Ala Lys
                405                 410                 415
Lys Trp Asn Leu Asn Tyr Lys Val Met Thr Tyr Ala Gly Ala Trp Lys
            420                 425                 430
Ala Thr Leu Gly Asn Leu Asp Asn Val Gly Lys His Tyr Tyr Val His
        435                 440                 445
Gly Gln His Ser Gly Lys Thr Ala
    450                 455

<210> 263
<211> 819
<212> DNA
<213> Artificial Sequence

<220>
<223> d6Elo(Tp) as by plasmid VC-LTM593-1qcz

<400> 263
atggatgctt ataacgctgc tatggataag attggagctg ctatcatcga ttggagtgat      60
ccagatggaa agttcagagc tgatagggag gattggtggt tgtgcgattt cagatccgct     120
atcaccattg ctctcatcta catcgctttc gtgatcttgg gatctgctgt gatgcaatct     180
ctcccagcta tggacccata ccctatcaag ttcctctaca acgtgtctca aatcttcctc     240
tgcgcttaca tgactgttga ggctggattc ctcgcttata ggaacggata caccgttatg     300
ccatgcaacc acttcaacgt gaacgatcca ccagttgcta acttgctctg gctcttctac     360
atctccaaag tgtgggattt ctgggatacc atcttcattg tgctcggaaa gaagtggaga     420
caactctctt tcttgcacgt gtaccaccac accaccatct tcctcttcta ctggttgaac     480
gctaacgtgc tctacgatgg agatatcttc ttgaccatcc tcctcaacgg attcattcac     540
accgtgatgt acacctacta cttcatctgc atgcacacca aggattctaa gaccggaaag     600
tctttgccaa tctggtggaa gtcatctttg accgctttcc aactcttgca attcaccatc     660
atgatgtccc aagctaccta cttggttttc cacggatgcg ataaggtttc cctcagaatc     720
accatcgtgt acttcgtgta cattctctcc cttttcttcc tcttcgctca gttcttcgtg     780
caatcctaca tggctccaaa gaagaagaag tccgcttga                            819

<210> 264
<211> 272
<212> PRT
<213> Thalassiosira pseudonana

<220>
<223> d6Elo(Tp) as by plasmid VC-LTM593-1qcz

<400> 264
Met Asp Ala Tyr Asn Ala Ala Met Asp Lys Ile Gly Ala Ala Ile Ile
1               5                   10                  15
Asp Trp Ser Asp Pro Asp Gly Lys Phe Arg Ala Asp Arg Glu Asp Trp
```

```
            20                  25                  30
Trp Leu Cys Asp Phe Arg Ser Ala Ile Thr Ile Ala Leu Ile Tyr Ile
        35                  40                  45
Ala Phe Val Ile Leu Gly Ser Ala Val Met Gln Ser Leu Pro Ala Met
    50                  55                  60
Asp Pro Tyr Pro Ile Lys Phe Leu Tyr Asn Val Ser Gln Ile Phe Leu
65                  70                  75                  80
Cys Ala Tyr Met Thr Val Glu Ala Gly Phe Leu Ala Tyr Arg Asn Gly
                85                  90                  95
Tyr Thr Val Met Pro Cys Asn His Phe Asn Val Asn Asp Pro Pro Val
            100                 105                 110
Ala Asn Leu Leu Trp Leu Phe Tyr Ile Ser Lys Val Trp Asp Phe Trp
        115                 120                 125
Asp Thr Ile Phe Ile Val Leu Gly Lys Lys Trp Arg Gln Leu Ser Phe
    130                 135                 140
Leu His Val Tyr His His Thr Thr Ile Phe Leu Phe Tyr Trp Leu Asn
145                 150                 155                 160
Ala Asn Val Leu Tyr Asp Gly Asp Ile Phe Leu Thr Ile Leu Leu Asn
                165                 170                 175
Gly Phe Ile His Thr Val Met Tyr Thr Tyr Tyr Phe Ile Cys Met His
            180                 185                 190
Thr Lys Asp Ser Lys Thr Gly Lys Ser Leu Pro Ile Trp Trp Lys Ser
        195                 200                 205
Ser Leu Thr Ala Phe Gln Leu Leu Gln Phe Thr Ile Met Met Ser Gln
    210                 215                 220
Ala Thr Tyr Leu Val Phe His Gly Cys Asp Lys Val Ser Leu Arg Ile
225                 230                 235                 240
Thr Ile Val Tyr Phe Val Tyr Ile Leu Ser Leu Phe Phe Leu Phe Ala
                245                 250                 255
Gln Phe Phe Val Gln Ser Tyr Met Ala Pro Lys Lys Lys Lys Ser Ala
            260                 265                 270
```

<210> 265
<211> 1197
<212> DNA
<213> Artificial Sequence

<220>
<223> d12Des(Ps) as by plasmid VC-LTM593-1qcz

<400> 265

```
atggctattt tgaaccctga ggctgattct gctgctaacc tcgctactga ttctgaggct      60
aagcaaagac aattggctga ggctggatac actcacgttg agggtgctcc tgctcctttg     120
cctttggagt tgcctcactt ctctctcaga gatctcagag ctgctattcc taagcactgc     180
ttcgagagat ctttcgtgac ctccacctac tacatgatca agaacgtgtt gacttgcgct     240
gctttgttct acgctgctac cttcattgat agagctggag ctgctgctta tgttttgtgg     300
cctgtgtact ggttcttcca gggatcttac ttgactggag tgtgggttat cgctcacgag     360
tgtggacacc aggcttattg ctcttctgag gtggtgaaca acttgattgg actcgtgttg     420
cactctgctt tgttggtgcc ttaccactct tggagaatct ctcacagaaa gcaccactcc     480
aacactggat cttgcgagaa cgatgaggtt ttcgttcctg tgaccagatc tgtgttggct     540
tcttcttgga acgagacctt ggaggattct cctctctacc aactctaccg tatcgtgtac     600
atgttggttg ttggatggat gcctggatac ctcttcttca acgctactgg acctactaag     660
tactggggaa agtctaggtc tcacttcaac ccttactccg ctatctatgc tgatagggag     720
aggtggatga tcgtgctctc cgatattttc ttggtggcta tgttggctgt tttggctgct     780
ttggtgcaca ctttctcctt caacacgatg gtgaagttct acgtggtgcc ttacttcatt     840
gtgaacgctt acttggtgtt gattacctac ctccaacaca ccgataccta catccctcac     900
ttcagagagg gagagtggaa ttggttgaga ggagctttgt gcactgtgga tagatcattt     960
ggtccattcc tcgattctgt ggtgcataga atcgtggata cccacgtttg ccaccatatc    1020
ttctccaaga tgcctttcta tcactgcgag gaggctacca acgctattaa gcctctcctc    1080
ggaaagttct acttgaagga tactactcct gttcctgttg ctctctggag atcttacacc    1140
cactgcaagt tcgttgagga tgatggaaag gtggtgttct acaagaacaa gttatag       1197
```

<210> 266
<211> 398
<212> PRT
<213> Phytophthora sojae

<220>

<223> d12Des(Ps) as by plasmid VC-LTM593-1qcz

<400> 266
```
Met Ala Ile Leu Asn Pro Glu Ala Asp Ser Ala Ala Asn Leu Ala Thr
1               5                   10                  15
Asp Ser Glu Ala Lys Gln Arg Gln Leu Ala Glu Ala Gly Tyr Thr His
            20                  25                  30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Glu Leu Pro His Phe Ser
        35                  40                  45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50                  55                  60
Phe Val Thr Ser Thr Tyr Tyr Met Ile Lys Asn Val Leu Thr Cys Ala
65                  70                  75                  80
Ala Leu Phe Tyr Ala Ala Thr Phe Ile Asp Arg Ala Gly Ala Ala Ala
                85                  90                  95
Tyr Val Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100                 105                 110
Gly Val Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115                 120                 125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
    130                 135                 140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145                 150                 155                 160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165                 170                 175
Ser Val Leu Ala Ser Ser Trp Asn Glu Thr Leu Glu Asp Ser Pro Leu
            180                 185                 190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195                 200                 205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210                 215                 220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ala Asp Arg Glu
225                 230                 235                 240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Ala Met Leu Ala
                245                 250                 255
Val Leu Ala Ala Leu Val His Thr Phe Ser Phe Asn Thr Met Val Lys
            260                 265                 270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275                 280                 285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Glu Gly
    290                 295                 300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305                 310                 315                 320
Gly Pro Phe Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
                325                 330                 335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340                 345                 350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Thr
        355                 360                 365
Thr Pro Val Pro Val Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
    370                 375                 380
Val Glu Asp Asp Gly Lys Val Val Phe Tyr Lys Asn Lys Leu
385                 390                 395
```

<210> 267
<211> 1092
<212> DNA
<213> Artificial Sequence

<220>
<223> o3Des(Pir) as by plasmid VC-LTM593-1qcz

<400> 267
```
atggcttcta catctgctgc tcaagacgct gctccttacg agttcccttc tctcactgag      60
atcaagaggg ctcttccttc tgagtgtttc gaggcttctg ttcctctttc tctctactac     120
accgctagat ctcttgctct tgctggatct ctcgctgttg ctctctctta cgctagagct     180
ttgcctcttg ttcaggctaa cgctcttctt gatgctactc tctgcactgg atacgttctt     240
ctccagggaa tcgttttctg gggattcttc accgttggtc acgattgtgg acacggagct     300
```

ttctctagat ctcacgtgct caacttctct gttggaaccc tcatgcactc tatcatcctt 360
accccctttcg agtcttggaa gctctctcac agacaccacc acaagaacac cggaaacatc 420
gataaggacg agatcttcta ccctcaaaga gaggctgatt ctcaccctgt ttctagacac 480
cttgtgatgt ctcttggatc tgcttggttc gcttaccttt tcgctggatt ccctcctaga 540
accatgaacc acttcaaccc ttgggaggct atgtatgtta gaagagtggc tgctgtgatc 600
atctctctcg gagttctttt cgctttcgct ggactctact cttacctcac cttcgttctt 660
ggattcacca ctatggctat ctactacttc ggacctctct tcatcttcgc taccatgctt 720
gttgttacca ctttcctcca ccacaacgat gaggagacac cttggtacgc tgattctgag 780
tggacttacg tgaagggaaa cctctcttct gtggacagat cttacggtgc tctcatcgac 840
aaccttagcc acaacatcgg aactcaccag atccaccacc tcttccctat catccctcac 900
tacaagctca acgatgctac tgctgctttc gctaaggctt tccctgagct tgttaggaaa 960
aacgctgctc ctatcatccc aactttcttc aggatggctg ctatgtacgc taagtacgga 1020
gttgttgaca ctgatgctaa gaccttcact ctcaaggagg ctaaggctgc tgctaagact 1080
aagtcatctt ga 1092

<210> 268
<211> 363
<212> PRT
<213> Pythium irregulare

<220>
<223> o3Des(Pir) as by plasmid VC-LTM593-1qcz

<400> 268
Met Ala Ser Thr Ser Ala Ala Gln Asp Ala Ala Pro Tyr Glu Phe Pro
1 5 10 15
Ser Leu Thr Glu Ile Lys Arg Ala Leu Pro Ser Glu Cys Phe Glu Ala
20 25 30
Ser Val Pro Leu Ser Leu Tyr Tyr Thr Ala Arg Ser Leu Ala Leu Ala
35 40 45
Gly Ser Leu Ala Val Ala Leu Ser Tyr Ala Arg Ala Leu Pro Leu Val
50 55 60
Gln Ala Asn Ala Leu Leu Asp Ala Thr Leu Cys Thr Gly Tyr Val Leu
65 70 75 80
Leu Gln Gly Ile Val Phe Trp Gly Phe Phe Thr Val Gly His Asp Cys
85 90 95
Gly His Gly Ala Phe Ser Arg Ser His Val Leu Asn Phe Ser Val Gly
100 105 110
Thr Leu Met His Ser Ile Ile Leu Thr Pro Phe Glu Ser Trp Lys Leu
115 120 125
Ser His Arg His His His Lys Asn Thr Gly Asn Ile Asp Lys Asp Glu
130 135 140
Ile Phe Tyr Pro Gln Arg Glu Ala Asp Ser His Pro Val Ser Arg His
145 150 155 160
Leu Val Met Ser Leu Gly Ser Ala Trp Phe Ala Tyr Leu Phe Ala Gly
165 170 175
Phe Pro Pro Arg Thr Met Asn His Phe Asn Pro Trp Glu Ala Met Tyr
180 185 190
Val Arg Arg Val Ala Ala Val Ile Ile Ser Leu Gly Val Leu Phe Ala
195 200 205
Phe Ala Gly Leu Tyr Ser Tyr Leu Thr Phe Val Leu Gly Phe Thr Thr
210 215 220
Met Ala Ile Tyr Tyr Phe Gly Pro Leu Phe Ile Phe Ala Thr Met Leu
225 230 235 240
Val Val Thr Thr Phe Leu His His Asn Asp Glu Glu Thr Pro Trp Tyr
245 250 255
Ala Asp Ser Glu Trp Thr Tyr Val Lys Gly Asn Leu Ser Ser Val Asp
260 265 270
Arg Ser Tyr Gly Ala Leu Ile Asp Asn Leu Ser His Asn Ile Gly Thr
275 280 285
His Gln Ile His His Leu Phe Pro Ile Ile Pro His Tyr Lys Leu Asn
290 295 300
Asp Ala Thr Ala Ala Phe Ala Lys Ala Phe Pro Glu Leu Val Arg Lys
305 310 315 320
Asn Ala Ala Pro Ile Ile Pro Thr Phe Phe Arg Met Ala Ala Met Tyr
325 330 335
Ala Lys Tyr Gly Val Val Asp Thr Asp Ala Lys Thr Phe Thr Leu Lys
340 345 350

Glu Ala Lys Ala Ala Ala Lys Thr Lys Ser Ser
        355   360

<210> 269
<211> 1086
<212> DNA
<213> Artificial Sequence

<220>
<223> o3Des(Pi) as by plasmid VC-LTM593-1qcz

<400> 269
atggctacaa aggaggctta cgttttccca actctcaccg agatcaagag atctctccca 60
aaggattgct tcgaggcttc tgtgcctttg tctctctact acactgtgag atgcttggtt 120
attgctgtgg ctttgacctt cggattgaac tacgctagag ctttgccaga ggttgagtct 180
ttctgggctt tggatgctgc tttgtgcact ggatatatcc tcctccaggg aattgtgttc 240
tggggattct tcactgttgg acacgatgct ggacacggag ctttctctag ataccacctc 300
ttgaacttcg ttgtgggaac cttcatgcac tctctcatct tgaccccatt cgagtcttgg 360
aagttgaccc acagacacca ccacaagaac accggaaaca tcgatagaga tgaggtgttc 420
tacccacaga gaaaggctga tgatcaccca ttgtccagga acttgatctt ggctttggga 480
gctgcttggc ttgcttattt ggtggaggga ttcccaccaa gaaaggtgaa ccacttcaac 540
ccattcgagc cactttttgt gagacaagtg tccgctgtgg ttatctcttt gctcgctcac 600
ttcttcgttg ctggactctc tatctacttg tctctccagt tgggacttaa gaccatggct 660
atctactact acggaccagt tttcgtgttc ggatctatgt tggtgattac caccttcttg 720
caccacaacg atgaggagac tccatggtat gctgattctg agtggactta cgtgaaggga 780
aacttgtcct ctgtggatag atcttacggt gctctcatcg ataacctctc ccacaacatc 840
ggaactcacc agatccacca cctcttccca attatcccac actacaagct caagaaggct 900
actgctgctt tccaccaagc tttcccagag cttgtgagaa agtccgatga gccaatcatc 960
aaggctttct tcagagtggg aaggttgtat gctaactacg gagtggttga tcaagaggct 1020
aagctcttca ctttgaagga ggctaaggct gctactgaag ctgctgctaa gaccaagtct 1080
acctga 1086

<210> 270
<211> 361
<212> PRT
<213> Phytophthora infestans

<220>
<223> o3Des(Pi) as by plasmid VC-LTM593-1qcz

<400> 270
Met Ala Thr Lys Glu Ala Tyr Val Phe Pro Thr Leu Thr Glu Ile Lys
1   5   10   15
Arg Ser Leu Pro Lys Asp Cys Phe Glu Ala Ser Val Pro Leu Ser Leu
            20   25   30
Tyr Tyr Thr Val Arg Cys Leu Val Ile Ala Val Ala Leu Thr Phe Gly
        35   40   45
Leu Asn Tyr Ala Arg Ala Leu Pro Glu Val Glu Ser Phe Trp Ala Leu
    50   55   60
Asp Ala Ala Leu Cys Thr Gly Tyr Ile Leu Leu Gln Gly Ile Val Phe
65   70   75   80
Trp Gly Phe Phe Thr Val Gly His Asp Ala Gly His Gly Ala Phe Ser
                85   90   95
Arg Tyr His Leu Leu Asn Phe Val Val Gly Thr Phe Met His Ser Leu
            100   105   110
Ile Leu Thr Pro Phe Glu Ser Trp Lys Leu Thr His Arg His His His
        115   120   125
Lys Asn Thr Gly Asn Ile Asp Arg Asp Glu Val Phe Tyr Pro Gln Arg
    130   135   140
Lys Ala Asp Asp His Pro Leu Ser Arg Asn Leu Ile Leu Ala Leu Gly
145   150   155   160
Ala Ala Trp Leu Ala Tyr Leu Val Glu Gly Phe Pro Pro Arg Lys Val
                165   170   175
Asn His Phe Asn Pro Phe Glu Pro Leu Phe Val Arg Gln Val Ser Ala
            180   185   190
Val Val Ile Ser Leu Leu Ala His Phe Phe Val Ala Gly Leu Ser Ile
        195   200   205
Tyr Leu Ser Leu Gln Leu Gly Leu Lys Thr Met Ala Ile Tyr Tyr Tyr

```
    210                 215                 220
Gly Pro Val Phe Val Phe Gly Ser Met Leu Val Ile Thr Thr Phe Leu
225                 230                 235                 240
His His Asn Asp Glu Glu Thr Pro Trp Tyr Ala Asp Ser Glu Trp Thr
                245                 250                 255
Tyr Val Lys Gly Asn Leu Ser Ser Val Asp Arg Ser Tyr Gly Ala Leu
            260                 265                 270
Ile Asp Asn Leu Ser His Asn Ile Gly Thr His Gln Ile His His Leu
        275                 280                 285
Phe Pro Ile Ile Pro His Tyr Lys Leu Lys Lys Ala Thr Ala Ala Phe
    290                 295                 300
His Gln Ala Phe Pro Glu Leu Val Arg Lys Ser Asp Glu Pro Ile Ile
305                 310                 315                 320
Lys Ala Phe Phe Arg Val Gly Arg Leu Tyr Ala Asn Tyr Gly Val Val
                325                 330                 335
Asp Gln Glu Ala Lys Leu Phe Thr Leu Lys Glu Ala Lys Ala Ala Thr
            340                 345                 350
Glu Ala Ala Ala Lys Thr Lys Ser Thr
        355                 360
```

<210> 271
<211> 1560
<212> DNA
<213> Artificial Sequence

<220>
<223> d4Des(Tc) as by plasmid VC-LTM593-1qcz

<400> 271

```
atgactgttg gatacgacga ggagatccca ttcgagcaag ttagggctca taacaagcca      60
gacgacgctt ggtgtgctat tcacggacac gtgtacgacg ttaccaagtt cgcttcagtt     120
cacccaggag gagatattat cttgctcgct gctggaaagg aagctactgt cctctacgag     180
acctaccatg ttagaggagt gtctgacgct gtgctcagaa agtacagaat aggaaagttg     240
ccagacggac aaggaggagc taacgagaag gagaagagaa ccttgtctgg attgtcctct     300
gcttcttact acacctggaa ctccgatttc tacagagtga tgagggagag agttgtggct     360
agattgaagg agagaggaaa ggctagaaga ggaggatacg aactctggat caaggctttc     420
ttgctccttg ttggattctg gtcctctctt tactggatgt gcaccctcga tccatctttc     480
ggagctatct tggctgctat gtctttggga gtgttcgctg cttttgttgg aacctgcatc     540
caacacgatg gaaaccacgg agctttcgct caatctagat gggttaacaa ggtggcagga     600
tggactttgg atatgatcgg agcttctgga atgacttggg agttccaaca cgtgttggga     660
caccacccat acactaactt gatcgaggag gagaacggat tgcaaaaggt gtccggaaag     720
aagatggata ccaagttggc tgatcaagag tctgatccag atgtgttctc cacctaccca     780
atgatgagat tgcacccttg gcaccagaag aggtggtatc acaggttcca gcacatctac     840
ggacctttca tcttcggatt catgaccatc aacaaggtgg tgactcaaga tgttggagtg     900
gtgttgagaa agagactctt ccaaatcgat gctgagtgca gatatgcttc cccaatgtac     960
gttgctaggt tctggattat gaaggctttg accgtgttgt atatggttgc tttgccttgt    1020
tatatgcaag gaccttggca cggattgaaa ctcttcgcta tcgctcactt cacttgcgga    1080
gaggttttgg ctaccatgtt catcgtgaac cacattatcg agggagtgtc ttacgcttct    1140
aaggatgctg ttaagggaac tatggctcca ccaaagacta tgcacggagt gaccccaatg    1200
aacaacacta gaaaggaggt tgaggctgag gcttctaagt ctggagctgt ggttaagtct    1260
gtgccattgg atgattgggc tgctgttcag tgccaaacct ctgtgaactg gtctgttgga    1320
tcttggtttt ggaaccactt ctctggagga ctcaaccacc aaatcgagca ccacctcttc    1380
ccaggattgt ctcacgagac ctactaccac atccaagacg tggttcaatc tacctgtgct    1440
gagtacggag ttccatacca acacgagcca tctttgtgga ctgcttactg gaagatgctc    1500
gaacacctta gacaattggg aaacgaggag actcacgagt catggcagag agctgcttga    1560
```

<210> 272
<211> 519
<212> PRT
<213> Thraustochytrium sp.

<220>
<223> d4Des(Tc) as by plasmid VC-LTM593-1qcz

<400> 272

```
Met Thr Val Gly Tyr Asp Glu Glu Ile Pro Phe Glu Gln Val Arg Ala
1               5                   10                  15
His Asn Lys Pro Asp Asp Ala Trp Cys Ala Ile His Gly His Val Tyr
```

```
                20                  25                  30
Asp Val Thr Lys Phe Ala Ser Val His Pro Gly Gly Asp Ile Ile Leu
            35                  40                  45
Leu Ala Ala Gly Lys Glu Ala Thr Val Leu Tyr Glu Thr Tyr His Val
    50                  55                  60
Arg Gly Val Ser Asp Ala Val Leu Arg Lys Tyr Arg Ile Gly Lys Leu
65                  70                  75                  80
Pro Asp Gly Gln Gly Gly Ala Asn Glu Lys Glu Lys Arg Thr Leu Ser
                85                  90                  95
Gly Leu Ser Ser Ala Ser Tyr Tyr Thr Trp Asn Ser Asp Phe Tyr Arg
            100                 105                 110
Val Met Arg Glu Arg Val Val Ala Arg Leu Lys Glu Arg Gly Lys Ala
        115                 120                 125
Arg Arg Gly Gly Tyr Glu Leu Trp Ile Lys Ala Phe Leu Leu Leu Val
    130                 135                 140
Gly Phe Trp Ser Ser Leu Tyr Trp Met Cys Thr Leu Asp Pro Ser Phe
145                 150                 155                 160
Gly Ala Ile Leu Ala Ala Met Ser Leu Gly Val Phe Ala Ala Phe Val
                165                 170                 175
Gly Thr Cys Ile Gln His Asp Gly Asn His Gly Ala Phe Ala Gln Ser
            180                 185                 190
Arg Trp Val Asn Lys Val Ala Gly Trp Thr Leu Asp Met Ile Gly Ala
        195                 200                 205
Ser Gly Met Thr Trp Glu Phe Gln His Val Leu Gly His His Pro Tyr
    210                 215                 220
Thr Asn Leu Ile Glu Glu Glu Asn Gly Leu Gln Lys Val Ser Gly Lys
225                 230                 235                 240
Lys Met Asp Thr Lys Leu Ala Asp Gln Glu Ser Asp Pro Asp Val Phe
                245                 250                 255
Ser Thr Tyr Pro Met Met Arg Leu His Pro Trp His Gln Lys Arg Trp
            260                 265                 270
Tyr His Arg Phe Gln His Ile Tyr Gly Pro Phe Ile Phe Gly Phe Met
        275                 280                 285
Thr Ile Asn Lys Val Val Thr Gln Asp Val Gly Val Val Leu Arg Lys
    290                 295                 300
Arg Leu Phe Gln Ile Asp Ala Glu Cys Arg Tyr Ala Ser Pro Met Tyr
305                 310                 315                 320
Val Ala Arg Phe Trp Ile Met Lys Ala Leu Thr Val Leu Tyr Met Val
                325                 330                 335
Ala Leu Pro Cys Tyr Met Gln Gly Pro Trp His Gly Leu Lys Leu Phe
            340                 345                 350
Ala Ile Ala His Phe Thr Cys Gly Glu Val Leu Ala Thr Met Phe Ile
        355                 360                 365
Val Asn His Ile Ile Glu Gly Val Ser Tyr Ala Ser Lys Asp Ala Val
    370                 375                 380
Lys Gly Thr Met Ala Pro Pro Lys Thr Met His Gly Val Thr Pro Met
385                 390                 395                 400
Asn Asn Thr Arg Lys Glu Val Glu Ala Glu Ala Ser Lys Ser Gly Ala
                405                 410                 415
Val Val Lys Ser Val Pro Leu Asp Asp Trp Ala Ala Val Gln Cys Gln
            420                 425                 430
Thr Ser Val Asn Trp Ser Val Gly Ser Trp Phe Trp Asn His Phe Ser
        435                 440                 445
Gly Gly Leu Asn His Gln Ile Glu His His Leu Phe Pro Gly Leu Ser
    450                 455                 460
His Glu Thr Tyr Tyr His Ile Gln Asp Val Val Gln Ser Thr Cys Ala
465                 470                 475                 480
Glu Tyr Gly Val Pro Tyr Gln His Glu Pro Ser Leu Trp Thr Ala Tyr
                485                 490                 495
Trp Lys Met Leu Glu His Leu Arg Gln Leu Gly Asn Glu Glu Thr His
            500                 505                 510
Glu Ser Trp Gln Arg Ala Ala
        515
```

<210> 273
<211> 1338
<212> DNA
<213> Artificial Sequence

<220>
<223> d4Des(Pl) as by plasmid VC-LTM593-1qcz

<400> 273
atgccaccta gtgctgctag tgaaggtggt gttgctgaac ttagagctgc tgaagttgct 60
agctacacta gaaaggctgt tgacgaaaga cctgacctca ctatagttgg tgacgctgtt 120
tacgacgcta aggcttttag ggacgagcac cctggtggtg ctcacttcgt tagccttttc 180
ggaggtaggg acgctactga ggcttttatg gaatatcacc gtagagcttg gcctaaggct 240
aggatgtcta agttcttcgt tggttcactt gacgctagcg agaagcctac tcaagctgat 300
tcagcttacc ttagactttg cgctgaggtt aacgctcttt tgcctaaggg tagcggagga 360
ttcgctcctc ctagctactg gcttaaggct gctgctcttg ttgttgctgc tgttagtata 420
gagggttata tgctccttag gggtaagacc cttttgctta gcgttttcct tggactcgtg 480
ttcgcttgga taggacttaa tattcagcac gacgctaatc acggtgctct tagtagacac 540
tcagtgatta actactgcct cggttacgct caggattgga taggtggtaa tatggtgctt 600
tggcttcaag agcacgttgt gatgcaccac ctccacacta acgacgttga cgctgatcct 660
gatcaaaagg ctcacggtgt tcttagactt aagcctactg acggttggat gccttggcac 720
gcacttcaac aactctatat ccttcctggt gaggctatgt acgcttttaa gcttcttttc 780
ttggacgccc ttgagcttct tgcttggagg tgggagggtg agaagattag ccctcttgct 840
agagctttgt tcgctcctgc tgttgcttgt aagcttggat tctgggctag attcgttgct 900
ctccctctct ggcttcaacc tactgttcac actgctttgt gtatctgtgc tactgtgtgt 960
actggtagct tctacctcgc cttcttcttc tttatctctc acaacttcga cggtgttggt 1020
agcgttggac ctaagggatc acttcctaga tcagctactt tcgttcaacg tcaggttgag 1080
actagctcta acgttggtgg ttactggctt ggagttctta acggtggact taactttcag 1140
atagagcacc acttgttccc taggcttcac cactcttact acgctcaaat agctcctgtg 1200
gttaggactc acatagagaa gctcggtttt aagtaccgtc acttccctac cgttggatct 1260
aaccttagct caatgcttca gcatatgggt aagatgggaa ctagacctgg tgctgagaag 1320
ggtggtaagg ctgagtag 1338

<210> 274
<211> 445
<212> PRT
<213> Pavlova lutheri

<220>
<223> d4Des(Pl) as by plasmid VC-LTM593-1qcz

<400> 274
Met Pro Pro Ser Ala Ala Ser Glu Gly Gly Val Ala Glu Leu Arg Ala
1 5 10 15
Ala Glu Val Ala Ser Tyr Thr Arg Lys Ala Val Asp Glu Arg Pro Asp
20 25 30
Leu Thr Ile Val Gly Asp Ala Val Tyr Asp Ala Lys Ala Phe Arg Asp
35 40 45
Glu His Pro Gly Gly Ala His Phe Val Ser Leu Phe Gly Gly Arg Asp
50 55 60
Ala Thr Glu Ala Phe Met Glu Tyr His Arg Arg Ala Trp Pro Lys Ala
65 70 75 80
Arg Met Ser Lys Phe Phe Val Gly Ser Leu Asp Ala Ser Glu Lys Pro
85 90 95
Thr Gln Ala Asp Ser Ala Tyr Leu Arg Leu Cys Ala Glu Val Asn Ala
100 105 110
Leu Leu Pro Lys Gly Ser Gly Gly Phe Ala Pro Pro Ser Tyr Trp Leu
115 120 125
Lys Ala Ala Ala Leu Val Val Ala Ala Val Ser Ile Glu Gly Tyr Met
130 135 140
Leu Leu Arg Gly Lys Thr Leu Leu Leu Ser Val Phe Leu Gly Leu Val
145 150 155 160
Phe Ala Trp Ile Gly Leu Asn Ile Gln His Asp Ala Asn His Gly Ala
165 170 175
Leu Ser Arg His Ser Val Ile Asn Tyr Cys Leu Gly Tyr Ala Gln Asp
180 185 190
Trp Ile Gly Gly Asn Met Val Leu Trp Leu Gln Glu His Val Val Met
195 200 205
His His Leu His Thr Asn Asp Val Asp Ala Asp Pro Asp Gln Lys Ala
210 215 220
His Gly Val Leu Arg Leu Lys Pro Thr Asp Gly Trp Met Pro Trp His
225 230 235 240

Ala Leu Gln Gln Leu Tyr Ile Leu Pro Gly Glu Ala Met Tyr Ala Phe
                245   250   255
Lys Leu Leu Phe Leu Asp Ala Leu Glu Leu Leu Ala Trp Arg Trp Glu
            260   265   270
Gly Glu Lys Ile Ser Pro Leu Ala Arg Ala Leu Phe Ala Pro Ala Val
        275   280   285
Ala Cys Lys Leu Gly Phe Trp Ala Arg Phe Val Ala Leu Pro Leu Trp
    290   295   300
Leu Gln Pro Thr Val His Thr Ala Leu Cys Ile Cys Ala Thr Val Cys
305   310   315   320
Thr Gly Ser Phe Tyr Leu Ala Phe Phe Phe Phe Ile Ser His Asn Phe
                325   330   335
Asp Gly Val Gly Ser Val Gly Pro Lys Gly Ser Leu Pro Arg Ser Ala
            340   345   350
Thr Phe Val Gln Arg Gln Val Glu Thr Ser Ser Asn Val Gly Gly Tyr
        355   360   365
Trp Leu Gly Val Leu Asn Gly Gly Leu Asn Phe Gln Ile Glu His His
    370   375   380
Leu Phe Pro Arg Leu His His Ser Tyr Tyr Ala Gln Ile Ala Pro Val
385   390   395   400
Val Arg Thr His Ile Glu Lys Leu Gly Phe Lys Tyr Arg His Phe Pro
                405   410   415
Thr Val Gly Ser Asn Leu Ser Ser Met Leu Gln His Met Gly Lys Met
            420   425   430
Gly Thr Arg Pro Gly Ala Glu Lys Gly Gly Lys Ala Glu
        435   440   445

<210> 275
<211> 903
<212> DNA
<213> Artificial Sequence

<220>
<223> d5Elo(Ot) as by plasmid VC-LTM593-1qcz

<400> 275
atgtctgcta gcggagcttt gttgcctgct atagctttcg ctgcttacgc ttacgctacc 60
tacgcttatg ctttcgagtg gagccacgct aacggaatcg ataacgtgga tgctagagag 120
tggattggag ctttgtcttt gagactccct gcaattgcaa ccacaatgta cctcttgttc 180
tgccttgtgg gacctagatt gatggctaag agggaggctt ttgatcctaa gggatttatg 240
ctcgcttaca acgcttacca aaccgctttc aacgttgtgg tgctcggaat gttcgctaga 300
gagatctctg gattgggaca acctgtttgg ggatctacta tgccttggag cgataggaag 360
tccttcaaga ttttgttggg agtgtggctc cactacaaca ataagtacct cgagttgttg 420
gatactgtgt tcatggtggc taggaaaaag accaagcagc tctctttctt gcacgtgtac 480
caccacgctt tgttgatttg ggcttggtgg cttgtttgtc acctcatggc taccaacgat 540
tgcatcgatg cttatttcgg agctgcttgc aactctttca tccacatcgt gatgtactcc 600
tactacctca tgtctgcttt gggaattagg tgcccttgga agagatatat cacccaggct 660
cagatgttgc aattcgtgat cgtgttcgct cacgctgttt tcgtgctcag acaaaagcac 720
tgccctgtta ctttgccttg ggcacaaatg ttcgtgatga caaatatgtt ggtgctcttc 780
ggaaacttct acctcaaggc ttactctaac aagtctaggg gagatggagc ttcttctgtt 840
aagcctgctg agactactag agcaccttct gtgagaagaa ccaggtcaag gaagatcgat 900
tga 903

<210> 276
<211> 300
<212> PRT
<213> Ostreococcus tauri

<220>
<223> d5Elo(Ot) as by plasmid VC-LTM593-1qcz

<400> 276
Met Ser Ala Ser Gly Ala Leu Leu Pro Ala Ile Ala Phe Ala Ala Tyr
1   5   10   15
Ala Tyr Ala Thr Tyr Ala Tyr Ala Phe Glu Trp Ser His Ala Asn Gly
            20   25   30
Ile Asp Asn Val Asp Ala Arg Glu Trp Ile Gly Ala Leu Ser Leu Arg
        35   40   45

```
Leu Pro Ala Ile Ala Thr Thr Met Tyr Leu Leu Phe Cys Leu Val Gly
    50                  55                  60
Pro Arg Leu Met Ala Lys Arg Glu Ala Phe Asp Pro Lys Gly Phe Met
65                  70                  75                  80
Leu Ala Tyr Asn Ala Tyr Gln Thr Ala Phe Asn Val Val Val Leu Gly
                85                  90                  95
Met Phe Ala Arg Glu Ile Ser Gly Leu Gly Gln Pro Val Trp Gly Ser
            100                 105                 110
Thr Met Pro Trp Ser Asp Arg Lys Ser Phe Lys Ile Leu Leu Gly Val
        115                 120                 125
Trp Leu His Tyr Asn Asn Lys Tyr Leu Glu Leu Leu Asp Thr Val Phe
    130                 135                 140
Met Val Ala Arg Lys Lys Thr Lys Gln Leu Ser Phe Leu His Val Tyr
145                 150                 155                 160
His His Ala Leu Leu Ile Trp Ala Trp Trp Leu Val Cys His Leu Met
                165                 170                 175
Ala Thr Asn Asp Cys Ile Asp Ala Tyr Phe Gly Ala Ala Cys Asn Ser
            180                 185                 190
Phe Ile His Ile Val Met Tyr Ser Tyr Tyr Leu Met Ser Ala Leu Gly
        195                 200                 205
Ile Arg Cys Pro Trp Lys Arg Tyr Ile Thr Gln Ala Gln Met Leu Gln
    210                 215                 220
Phe Val Ile Val Phe Ala His Ala Val Phe Val Leu Arg Gln Lys His
225                 230                 235                 240
Cys Pro Val Thr Leu Pro Trp Ala Gln Met Phe Val Met Thr Asn Met
                245                 250                 255
Leu Val Leu Phe Gly Asn Phe Tyr Leu Lys Ala Tyr Ser Asn Lys Ser
            260                 265                 270
Arg Gly Asp Gly Ala Ser Ser Val Lys Pro Ala Glu Thr Thr Arg Ala
        275                 280                 285
Pro Ser Val Arg Arg Thr Arg Ser Arg Lys Ile Asp
    290                 295                 300

<210> 277
<211> 2013
<212> DNA
<213> Artificial Sequence

<220>
<223> AHAS as by plasmid VC-LTM593-1qcz

<400> 277
atggcggcgg caacaacaac aacaacaaca tcttcttcga tctccttctc caccaaacca      60
tctccttcct cctccaaatc accattacca atctccagat tctccctccc attctcccta     120
aaccccaaca aatcatcctc ctcctcccgc cgccgcggta tcaaatccag ctctccctcc     180
tccatctccg ccgtgctcaa cacaaccacc aatgtcacaa ccactccctc tccaaccaaa     240
cctaccaaac ccgaaacatt catctcccga ttcgctccag atcaaccccg caaaggcgct     300
gatatcctcg tcgaggcttt agaacgtcaa ggcgtagaaa ccgtattcgc ttaccctgga     360
ggtacatcaa tggagattca ccaagcctta acccgctctt cctcaatccg taacgtcctt     420
cctcgtcacg aacaaggagg tgtattcgca gcagaaggat acgctcgatc ctcaggtaaa     480
ccaggtatct gtatagccac ttcaggtccc ggagctacaa atctcgttag cggattagcc     540
gatgcgttgt tagatagtgt tcctcttgta gcaatcacag gacaagtccc tcgtcgtatg     600
attggtacag atgcgtttca agagactccg attgttgagg taacgcgttc gattacgaag     660
cataactatc ttgtgatgga tgttgaagat atcccaagga ttattgaaga ggctttcttt     720
ttagctactt ctggtagacc tggacctgtt ttggttgatg ttcctaaaga tattcaacaa     780
cagcttgcga ttcctaattg ggaacaggct atgagattac ctggttatat gtctaggatg     840
cctaaacctc cggaagattc tcatttggag cagattgtta ggttgatttc tgagtctaag     900
aagcctgtgt tgtatgttgg tggtggttgt cttaattcta gcgatgaatt gggtaggttt     960
gttgagctta cgggcatccc tgttgcgagt acgttgatgg ggctgggatc ttatccttgt    1020
gatgatgagt tgtcgttaca tatgcttgga atgcatggga ctgtgtatgc aaattacgct    1080
gtggagcata gtgatttgtt gttggcgttt ggggtaaggt ttgatgatcg tgtcacgggt    1140
aaacttgagg cttttgctag tagggctaag attgttcata ttgatattga ctcggctgag    1200
attgggaaga ataagactcc tcatgtgtct gtgtgtggtg atgttaagct ggctttgcaa    1260
gggatgaata aggttcttga gaaccgagcg gaggagctta aacttgattt tggagtttgg    1320
aggaatgagt tgaacgtaca gaaacagaag tttccgttga gctttaagac gtttggggaa    1380
gctattcctc cacagtatgc gattaaggtc cttgatgagt tgactgatgg aaaagccata    1440
ataagtactg gtgtcgggca acatcaaatg tgggcggcgc agttctacaa ttacaagaaa    1500
ccaaggcagt ggctatcatc aggaggcctt ggagctatgg gatttggact tcctgctgcg    1560
```

attggagcgt ctgttgctaa ccctgatgcg atagttgtgg atattgacgg agatggaagt 1620
tttataatga atgtgcaaga gctagccact attcgtgtag agaatcttcc agtgaaggta 1680
cttttattaa acaaccagca tcttggcatg gttatgcaat gggaagatcg gttctacaaa 1740
gctaaccgag ctcacacatt tctcggggac ccggctcagg aggacgagat attcccgaac 1800
atgttgctgt ttgcagcagc ttgcgggatt ccagcggcga gggtgacaaa gaaagcagat 1860
ctccgagaag ctattcagac aatgctggat acaccaggac cttacctgtt ggatgtgatt 1920
tgtccgcacc aagaacatgt gttgccgatg atcccgaatg gtggcacttt caacgatgtc 1980
ataacggaag gagatggccg gattaaatac tga 2013

<210> 278
<211> 670
<212> PRT
<213> Arabidopsis thaliana

<220>
<223> AHAS as by plasmid VC-LTM593-1qcz

<400> 278
Met Ala Ala Ala Thr Thr Thr Thr Thr Thr Ser Ser Ser Ile Ser Phe
1 5 10 15
Ser Thr Lys Pro Ser Pro Ser Ser Ser Lys Ser Pro Leu Pro Ile Ser
20 25 30
Arg Phe Ser Leu Pro Phe Ser Leu Asn Pro Asn Lys Ser Ser Ser Ser
35 40 45
Ser Arg Arg Arg Gly Ile Lys Ser Ser Ser Pro Ser Ser Ile Ser Ala
50 55 60
Val Leu Asn Thr Thr Thr Asn Val Thr Thr Thr Pro Ser Pro Thr Lys
65 70 75 80
Pro Thr Lys Pro Glu Thr Phe Ile Ser Arg Phe Ala Pro Asp Gln Pro
85 90 95
Arg Lys Gly Ala Asp Ile Leu Val Glu Ala Leu Glu Arg Gln Gly Val
100 105 110
Glu Thr Val Phe Ala Tyr Pro Gly Gly Thr Ser Met Glu Ile His Gln
115 120 125
Ala Leu Thr Arg Ser Ser Ser Ile Arg Asn Val Leu Pro Arg His Glu
130 135 140
Gln Gly Gly Val Phe Ala Ala Glu Gly Tyr Ala Arg Ser Ser Gly Lys
145 150 155 160
Pro Gly Ile Cys Ile Ala Thr Ser Gly Pro Gly Ala Thr Asn Leu Val
165 170 175
Ser Gly Leu Ala Asp Ala Leu Leu Asp Ser Val Pro Leu Val Ala Ile
180 185 190
Thr Gly Gln Val Pro Arg Arg Met Ile Gly Thr Asp Ala Phe Gln Glu
195 200 205
Thr Pro Ile Val Glu Val Thr Arg Ser Ile Thr Lys His Asn Tyr Leu
210 215 220
Val Met Asp Val Glu Asp Ile Pro Arg Ile Ile Glu Glu Ala Phe Phe
225 230 235 240
Leu Ala Thr Ser Gly Arg Pro Gly Pro Val Leu Val Asp Val Pro Lys
245 250 255
Asp Ile Gln Gln Gln Leu Ala Ile Pro Asn Trp Glu Gln Ala Met Arg
260 265 270
Leu Pro Gly Tyr Met Ser Arg Met Pro Lys Pro Pro Glu Asp Ser His
275 280 285
Leu Glu Gln Ile Val Arg Leu Ile Ser Glu Ser Lys Lys Pro Val Leu
290 295 300
Tyr Val Gly Gly Gly Cys Leu Asn Ser Ser Asp Glu Leu Gly Arg Phe
305 310 315 320
Val Glu Leu Thr Gly Ile Pro Val Ala Ser Thr Leu Met Gly Leu Gly
325 330 335
Ser Tyr Pro Cys Asp Asp Glu Leu Ser Leu His Met Leu Gly Met His
340 345 350
Gly Thr Val Tyr Ala Asn Tyr Ala Val Glu His Ser Asp Leu Leu Leu
355 360 365
Ala Phe Gly Val Arg Phe Asp Asp Arg Val Thr Gly Lys Leu Glu Ala
370 375 380
Phe Ala Ser Arg Ala Lys Ile Val His Ile Asp Ile Asp Ser Ala Glu
385 390 395 400

```
Ile Gly Lys Asn Lys Thr Pro His Val Ser Val Cys Gly Asp Val Lys
                405                 410                 415
Leu Ala Leu Gln Gly Met Asn Lys Val Leu Glu Asn Arg Ala Glu Glu
            420                 425                 430
Leu Lys Leu Asp Phe Gly Val Trp Arg Asn Glu Leu Asn Val Gln Lys
        435                 440                 445
Gln Lys Phe Pro Leu Ser Phe Lys Thr Phe Gly Glu Ala Ile Pro Pro
    450                 455                 460
Gln Tyr Ala Ile Lys Val Leu Asp Glu Leu Thr Asp Gly Lys Ala Ile
465                 470                 475                 480
Ile Ser Thr Gly Val Gly Gln His Gln Met Trp Ala Ala Gln Phe Tyr
                485                 490                 495
Asn Tyr Lys Lys Pro Arg Gln Trp Leu Ser Ser Gly Gly Leu Gly Ala
            500                 505                 510
Met Gly Phe Gly Leu Pro Ala Ala Ile Gly Ala Ser Val Ala Asn Pro
        515                 520                 525
Asp Ala Ile Val Val Asp Ile Asp Gly Asp Gly Ser Phe Ile Met Asn
    530                 535                 540
Val Gln Glu Leu Ala Thr Ile Arg Val Glu Asn Leu Pro Val Lys Val
545                 550                 555                 560
Leu Leu Leu Asn Asn Gln His Leu Gly Met Val Met Gln Trp Glu Asp
                565                 570                 575
Arg Phe Tyr Lys Ala Asn Arg Ala His Thr Phe Leu Gly Asp Pro Ala
            580                 585                 590
Gln Glu Asp Glu Ile Phe Pro Asn Met Leu Leu Phe Ala Ala Ala Cys
        595                 600                 605
Gly Ile Pro Ala Ala Arg Val Thr Lys Lys Ala Asp Leu Arg Glu Ala
    610                 615                 620
Ile Gln Thr Met Leu Asp Thr Pro Gly Pro Tyr Leu Leu Asp Val Ile
625                 630                 635                 640
Cys Pro His Gln Glu His Val Leu Pro Met Ile Pro Asn Gly Gly Thr
                645                 650                 655
Phe Asn Asp Val Ile Thr Glu Gly Asp Gly Arg Ile Lys Tyr
            660                 665                 670
```

<210> 279
<211> 60074
<212> DNA
<213> Artificial Sequence

<220>
<223> vector VC-LTM593-1qcz rc

<400> 279

```
cctgccagtc agcatcatca caccaaaagt taggcccgaa tagtttgaaa ttagaaagct      60
cgcaattgag gtctacaggc caaattcgct cttagccgta caatattact caccggtgcg     120
atgcccccca tcgtaggtga aggtggaaat taatggcgcg cctgatcact gattagtaac     180
tattacgtaa gcctacgtag cgtcacgtga cgttagctaa cgctacgtag cctcagctga     240
cgttacgtaa gcctacgtag cgtcacgtga gcttagctaa cgctacctag gctcagctga     300
cgttacgtaa cgctagctag cgtcactcct gcagcaaatt tacacattgc cactaaacgt     360
ctaaaccctt gtaatttgtt tttgttttac tatgtgtgtt atgtatttga tttgcgataa     420
atttttatat ttggtactaa atttataaca ccttttatgc taacgtttgc caacacttag     480
caatttgcaa gttgattaat tgattctaaa ttatttttgt cttctaaata catatactaa     540
tcaactggaa atgtaaatat ttgctaatat ttctactata ggagaattaa agtgagtgaa     600
tatggtacca caaggtttgg agatttaatt gttgcaatgc tgcatggatg gcatatacac     660
caaacattca ataattcttg aggataataa tggtaccaca caagatttga ggtgcatgaa     720
cgtcacgtgg acaaaaggtt tagtaatttt tcaagacaac aatgttacca cacacaagtt     780
ttgaggtgca tgcatggatg ccctgtggaa agtttaaaaa tattttggaa atgatttgca     840
tggaagccat gtgtaaaacc atgacatcca cttggaggat gcaataatga agaaaactac     900
aaatttacat gcaactagtt atgcatgtag tctatataat gaggattttg caatactttc     960
attcatacac actcactaag ttttacacga ttataatttc ttcatagcca gtactgttta    1020
agcttcactg tctctgaatc ggcaaaggta aacgtatcaa ttattctaca aaccctttta    1080
tttttctttt gaattaccgt cttcattggt tatatgataa cttgataagt aaagcttcaa    1140
taattgaatt tgatctgtgt ttttttggcc ttaatactaa atccttacat aagctttgtt    1200
gcttctcctc ttgtgagttg agtgttaagt tgtaataatg gttcactttc agctttagaa    1260
gaaaccatgg aagttgttga gaggttctac ggagagttgg atggaaaggt ttcccaagga    1320
gtgaacgctt tgttgggatc tttcggagtt gagttgactg ataccccaac tactaaggga    1380
ttgccactcg ttgattctcc aactccaatt gtgttgggag tgtctgttta cttgaccatc    1440
```

gtgatcggag gattgctttg gatcaaggct agagatctca agccaagagc ttctgagcca 1500
ttcttgttgc aagctttggt gttggtgcac aacttgttct gcttcgcttt gtctctttac 1560
atgtgcgtgg gtatcgctta ccaagctatc acctggagat attccttgtg gggaaacgct 1620
tataacccaa agcacaagga gatggctatc ctcgtttacc tcttctacat gtccaagtac 1680
gtggagttca tggataccgt gatcatgatc ctcaagagat ccaccagaca gatttctttc 1740
ctccacgtgt accaccactc ttctatctcc cttatctggt gggctattgc tcaccacgct 1800
ccaggaggag aggcttattg gagtgctgct ctcaactctg gagtgcacgt gttgatgtac 1860
gcttactact tcttggctgc ttgcttgaga tcttccccaa agctcaagaa caagtacctc 1920
ttctggggaa gatacctcac ccaattccag atgttccagt tcatgctcaa cttggtgcaa 1980
gcttactacg atatgaaaac caacgctcca tatccacaat ggctcatcaa gatcctcttc 2040
tactacatga tctccctctt gttcctcttc ggaaacttct acgtgcaaaa gtacatcaag 2100
ccatccgatg gaaagcaaaa gggagctaag accgagtgat cgacaagctc gagtttctcc 2160
ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg gtttcgctca 2220
tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata cttctatcaa 2280
taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc ccgaattaat 2340
tcggcgttaa ttcagctagc tagcctcagc tgacgttacg taacgctagg tagcgtcacg 2400
tgacgttagc taacgctagg tagcgtcagc tgagcttacg taagcgctta gcagatattt 2460
ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg 2520
gacaacgttg ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca 2580
tgagttgcaa attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg 2640
agagagtctt tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag 2700
tctttttggt gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag 2760
gctgtaaaag attgtaaaag actatttgg tgttttggat aaaatgatag tttttataga 2820
ttcttttgct tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg 2880
aaatcgattg aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt 2940
ctctccattt ttatacctat ttaaccgtaa tcgattctaa tagatgatcg atttttata 3000
taatcctaat taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat 3060
agaatcagta ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt 3120
tttaattttt ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc 3180
aaggtaagag aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa 3240
atgtacactt gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt 3300
attaaaatac cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa 3360
aagaacccac gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac 3420
tatataaacc caccatcccc aatctcacca aacccaccac acaactcaca actcactctc 3480
acaccttaaa gaaccaatca ccaccaaaaa atttcacgat ttggaatttg attcctgcga 3540
tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt ctttgtgatg 3600
ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga 3660
aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca tgttctttgt 3720
tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt cttactgatc 3780
gttattagga gtttggggaa aaaggaagag ttttttttggt tggttcgagt gattatgagg 3840
ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac catgggaaaa 3900
ggatctgagg gaagatctgc tgctagagag atgactgctg aggctaacgg agataagaga 3960
aagaccatcc tcattgaggg agtgttgtac gatgctacca acttcaaaca cccaggaggt 4020
tccattatta acttcctcac cgagggagaa gctggagttg atgctaccca agcttacaga 4080
gagttccatc agagatccgg aaaggctgat aagtacctca agtccctccc aaagttggat 4140
gcttctaagg tggagtctag gttctctgct aaggagcagg ctagaaggga cgctatgacc 4200
agggattacg ctgctttcag agaggagttg gttgctgagg gatacttcga tccatctatc 4260
ccacacatga tctacagagt ggtggagatt gtggctttgt tcgctttgtc tttctggttg 4320
atgtctaagg cttctccaac ctctttggtt ttgggagtgg tgatgaacgg aatcgctcaa 4380
ggaagatgcg gatgggttat gcacgagatg ggacacggat ctttcactgg agttatctgg 4440
ctcgatgata ggatgtgcga gttcttctac ggagttggat gtggaatgtc tggacactac 4500
tggaagaacc agcactctaa gcaccacgct gctccaaaca gattggagca cgatgtggat 4560
ttgaacacct tgccactcgt tgctttcaac gagagagttg tgaggaaggt taagccagga 4620
tctttgttgg ctttgtggct cagagttcag gcttatttgt tcgctccagt gtcttgcttg 4680
ttgatcggat tgggatggac cttgtacttg cacccaagat atatgctcag gaccaagaga 4740
cacatggagt ttgtgtggat cttcgctaga tatatcggat ggttctcctt gatgggagct 4800
ttgggatatt ctcctggaac ttctgtggga atgtacctct gctctttcgg acttggatgc 4860
atctacatct tcctccaatt cgctgtgtct cacacccact tgccagttac caacccagag 4920
gatcaattgc actggcttga gtacgctgct gatcacaccg tgaacatctc taccaagtct 4980
tggttggtta cctggtggat gtctaacctc aacttccaaa tcgagcacca cttgttccca 5040
accgctccac aattcaggtt caaggagatc tctccaagag ttgaggctct cttcaagaga 5100
cacaacctcc cttactacga tttgccatac acctctgctg tttctactac cttcgctaac 5160
ctctactctg ttggacactc tgttggagct gataccaaga agcaggattg actgctttaa 5220
tgagatatgc gagacgccta tgatcgcatg atatttgctt tcaattctgt tgtgcacgtt 5280
gtaaaaaacc tgagcatgtg tagctcagat ccttaccgcc ggtttcggtt cattctaatg 5340
aatatatcac ccgttactat cgtattttta tgaataatat tctccgttca atttactgat 5400
tgtctacgta ggctcagctg agcttaccta aggctacgta ggctcacgtg acgttacgta 5460
aggctacgta gcgtcacgtg agcttaccta actctagcta gcctcacgtg accttagcta 5520

acactaggta gcgtcagctc gacggcccgg actgtatcca acttctgatc tttgaatctc 5580
tctgttccaa catgttctga aggagttcta agacttttca gaaagcttgt aacatgcttt 5640
gtagactttc tttgaattac tcttgcaaac tctgattgaa cctacgtgaa aactgctcca 5700
gaagttctaa ccaaattccg tcttgggaag gcccaaaatt tattgagtac ttcagtttca 5760
tggacgtgtc ttcaaagatt tataacttga aatcccatca tttttaagag aagttctgtt 5820
ccgcaatgtc ttagatctca ttgaaatcta caactcttgt gtcagaagtt cttccagaat 5880
caacttgcat catggtgaaa atctggccag aagttctgaa cttgtcatat ttcttaacag 5940
ttagaaaaat ttctaagtgt ttagaatttt gacttttcca aagcaaactt gacttttgac 6000
tttcttaata aaacaaactt catattctaa catgtcttga tgaaatgtga ttcttgaaat 6060
ttgatgttga tgcaaaagtc aaagtttgac ttttcagtgt gcaattgacc attttgctct 6120
tgtgccaatt ccaaacctaa attgatgtat cagtgctgca aacttgatgt catggaagat 6180
cttatgagaa aattcttgaa gactgagagg aaaaattttg tagtacaaca caaagaatcc 6240
tgtttttcat agtcggacta gacacattaa cataaaacac cacttcattc gaagagtgat 6300
tgaagaagga aatgtgcagt tacctttctg cagttcataa gagcaactta cagacacttt 6360
tactaaaata ctacaaagag gaagatttta acaacttaga gaagtaatgg gagttaaaga 6420
gcaacacatt aagggggagt gttaaaatta atgtgttgta accaccacta cctttagtaa 6480
gtattataag aaaattgtaa tcatcacatt ataattattg tccttattta aaattatgat 6540
aaagttgtat cattaagatt gagaaaacca aatagtcctc gtcttgattt ttgaattatt 6600
gttttctatg ttacttttct tcaagcctat ataaaaactt tgtaatgcta aattgtatgc 6660
tggaaaaaaa tgtgtaatga attgaataga aattatggta tttcaaagtc caaaatccat 6720
caatagaaat ttagtacaaa acgtaactca aaaatattct cttattttaa attttacaac 6780
aatataaaaa tattctctta ttttaaattt tacaataata taatttatca cctgtcacct 6840
ttagaatacc accaacaata ttaatactta gatattttat tcttaataat tttgagatct 6900
ctcaatatat ctgatattta ttttatattt gtgtcatatt ttcttatgtt ttagagttaa 6960
cccttatatc ttggtcaaac tagtaattca atatatgagt ttgtgaagga cacattgaca 7020
tcttgaaaca ttggttttaa ccttgttgga atgttaaagg taataaaaca ttcagaatta 7080
tgaccatcta ttaatatact tcctttgtct tttaaaaaag tgtgcatgaa aatgctctat 7140
ggtaagctag agtgtcttgc tggcctgtgt atatcaattc catttccaga tggtagaaac 7200
tgccactacg aataattagt cataagacac gtatgttaac acacgtcccc ttgcatgttt 7260
tttgccatat attccgtctc tttctttttc ttcacgtata aaacaatgaa ctaattaata 7320
gagcgatcaa gctgaacagt tctttgcttt cgaagttgcc gcaacctaaa caggtttttc 7380
cttcttcttt cttcttatta actacgacct tgtcctttgc ctatgtaaaa ttactaggtt 7440
ttcatcagtt acactgatta agttcgttat agtggaagat aaaatgccct caaagcattt 7500
tgcaggatat ctttgatttt tcaaagatat ggaactgtag agtttgatag tgttcttgaa 7560
tgtggttgca tgaagttttt ttggtctgca tgttattttt tcctcgaaat atgttttgag 7620
tccaacaagt gattcacttg ggattcagaa agttgttttc tcaatatgta acagtttttt 7680
tctatggaga aaaatcatag ggaccgttgg ttttggcttc tttaattttg agctcagatt 7740
aaacccattt tacccggtgt tcttggcaga attgaaaaca gtacgtagta ccgcgcctac 7800
catgtgtgtt gagaccgaga acaacgatgg aatccctact gtggagatcg ctttcgatgg 7860
agagagagaa agagctgagg ctaacgtgaa gttgtctgct gagaagatgg aacctgctgc 7920
tttggctaag accttcgcta gaagatacgt ggttatcgag ggagttgagt acgatgtgac 7980
cgatttcaaa catcctggag gaaccgtgat ttctacgctt ctctctaaca ctggagctga 8040
tgctactgag gctttcaagg agttccacca cagatctaga aaggctagga aggctttggc 8100
tgctttgcct tctagacctg ctaagaccgc taaagtggat gatgctgaga tgctccagga 8160
tttcgctaag tggagaaagg agttggagag ggacggattc ttcaagcctt ctcctgctca 8220
tgttgcttac agattcgctg agttggctgc tatgtacgct ttgggaacct acttgatgta 8280
cgctagatac gttgtgtcct ctgtgttggt ttacgcttgc ttcttcggag ctagatgtgg 8340
atgggttcaa cacgagggag gacactcttc tttgaccgga aacatctggt gggataagag 8400
aatccaagct ttcactgctg gattcggatt ggctggatct ggagatatgt ggaactccat 8460
gcacaacaag caccacgcta ctcctcaaaa agtgaggcac gatatggatt tggataccac 8520
tcctgctgtt gctttcttca acaccgctgt ggaggataat agacctaggg gattctctaa 8580
gtactggctc agattgcaag cttggacctt cattcctgtg acttctggat tggtgttgct 8640
cttctggatg ttcttcctcc acccttctaa ggctttgaag ggaggaaagt acgaggagct 8700
tgtgtggatg ttggctgctc acgtgattag aacctggacc attaaggctg ttactggatt 8760
caccgctatg caatcctacg gactcttctt ggctacttct tgggtttccg gatgctactt 8820
gttcgctcac ttctctactt ctcacaccca cttggatgtt gttcctgctg atgagcactt 8880
gtcttgggtt aggtacgctg tggatcacac cattgatatc gatccttctc agggatgggt 8940
taactggttg atgggatact tgaactgcca agtgattcac cacctcttcc cttctatgcc 9000
tcaattcaga caacctgagg tgtccagaag attcgttgct ttcgctaaga agtggaacct 9060
caactacaag gtgatgactt atgctggagc ttggaaggct actttgggaa acctcgataa 9120
tgtgggaaag cactactacg tgcacggaca acactctgga aagaccgctt gattaatgaa 9180
ggccgcctcg accgtacccc ctgcagatag actatactat gttttagcct gcctgctggc 9240
tagctactat gttatgttat gttgtaaaat aaacacctgc taaggtatat ctatctatat 9300
tttagcatgg ctttctcaat aaattgtctt tccttatcgt ttactatctt atacctaata 9360
atgaaataat aatatcacat atgaggaacg gggcaggttt aggcatatat atacgagtgt 9420
agggcggagt ggggctacgt agcgtcacgt gacgttacct aagcctaggt agcctcagct 9480
gacgttacgt aacgctaggt aggctcagct gacacgggca ggacataggg actactacaa 9540
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa 9600

agtgctagag gggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca 9660
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg 9720
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa 9780
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat 9840
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc 9900
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag 9960
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata 10020
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag 10080
atttgtgcat tttgttgaat ataaattgac aatttttttt atttaattat agattattta 10140
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt 10200
aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca 10260
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt 10320
taatcgggta aaacctgatt actaaatata tattttttat ttgataaaca aaacaaaaat 10380
gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt 10440
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat 10500
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag 10560
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact 10620
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac 10680
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga 10740
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt 10800
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt 10860
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact 10920
tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata 10980
tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg 11040
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta 11100
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc 11160
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc 11220
gacattttta tcataaatct ggtgcttaaa cactctggtg agttctagta cttctgctat 11280
gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt tcttgatttt 11340
tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt tttttgtgg 11400
ttaatttagt ttcctatgtt cttcgattgt attatgcatg atctgtgttt ggattctgtt 11460
agattatgta ttggtgaata tgtatgtgtt tttgcatgtc tggttttggt cttaaaaatg 11520
ttcaaatctg atgatttgat tgaagctttt ttagtgttgg tttgattctt ctcaaaacta 11580
ctgttaattt actatcatgt tttccaactt tgattcatga tgacactttt gttctgcttt 11640
gttataaaat tttggttggt ttgattttgt aattatagtg taattttgtt aggaatgaac 11700
atgttttaat actctgtttt cgatttgtca cacattcgaa ttattaatcg ataatttaac 11760
tgaaaattca tggttctaga tcttgttgtc atcagattat ttgtttcgat aattcatcaa 11820
atatgtagtc cttttgctga tttgcgactg tttcattttt tctcaaaatt gtttttgtt 11880
aagtttatct aacagttatc gttgtcaaaa gtctctttca ttttgcaaaa tcttcttttt 11940
ttttttgttt gtaactttgt tttttaagct acacatttag tctgtaaaat agcatcgagg 12000
aacagttgtc ttagtagact tgcatgttct tgtaacttct atttgtttca gtttgttgat 12060
gactgctttg attttgtagg tcaaaggcgc accctaccat ggatgcttat aacgctgcta 12120
tggataagat tggagctgct atcatcgatt ggagtgatcc agatggaaag ttcagagctg 12180
atagggagga ttggtggttg tgcgatttca gatccgctat caccattgct ctcatctaca 12240
tcgctttcgt gatcttggga tctgctgtga tgcaatctct cccagctatg gacccatacc 12300
ctatcaagtt cctctacaac gtgtctcaaa tcttcctctg cgcttacatg actgttgagg 12360
ctggattcct cgcttatagg aacggataca ccgttatgcc atgcaaccac ttcaacgtga 12420
acgatccacc agttgctaac ttgctctggc tcttctacat ctccaaagtg tgggatttct 12480
gggataccat cttcattgtg ctcggaaaga agtggagaca actctctttc ttgcacgtgt 12540
accaccacac caccatcttc ctcttctact ggttgaacgc taacgtgctc tacgatggag 12600
atatcttctt gaccatcctc ctcaacggat tcattcacac cgtgatgtac acctactact 12660
tcatctgcat gcacaccaag gattctaaga ccggaaagtc tttgccaatc tggtggaagt 12720
catctttgac cgctttccaa ctcttgcaat tcaccatcat gatgtcccaa gctacctact 12780
tggttttcca cggatgcgat aaggtttccc tcagaatcac catcgtgtac ttcgtgtaca 12840
ttctctccct tttcttcctc ttcgctcagt tcttcgtgca atcctacatg gctccaaaga 12900
agaagaagtc cgcttgatgt taatgaaggc cgcagatatc agatctggtc gacctagagg 12960
atccccggcc gcaaagataa taacaaaagc ctactatata acgtacatgc aagtattgta 13020
tgatattaat gtttttacgt acgtgtaaac aaaaataatt acgtttgtaa cgtatggtga 13080
tgatgtggtg cactaggtgt aggccttgta ttaataaaaa gaagtttgtt ctatatagag 13140
tggtttagta cgacgattta tttactagtc ggattggaat agagaaccga attcttcaat 13200
ccttgctttt gatcaagaat tgaaaccgaa tcaaatgtaa aagttgatat atttgaaaaa 13260
cgtattgagc ttatgaaaat gctaatactc tcatctgtat ggaaaagtga ctttaaaacc 13320
gaacttaaaa gtgacaaaag gggaatatcg catcaaaccg aatgaaaccg atctacgtag 13380
gctcagctga gcttagctaa gcctacctag cctcacgtga gattatgtaa ggctaggtag 13440
cgtcacgtga cgttacctaa cactagctag cgtcagctga gcttagctaa ccctacgtag 13500
cctcacgtga gcttacctaa cgctacgtag cctcacgtga ctaaggatga cctacccatt 13560
cttgagacaa atgttacatt ttagtatcag agtaaaatgt gtacctataa ctcaaattcg 13620
attgacatgt atccattcaa cataaaatta aaccagcctg cacctgcatc cacatttcaa 13680

gtattttcaa accgttcggc tcctatccac cgggtgtaac aagacggatt ccgaatttgg 13740
aagattttga ctcaaattcc caatttatat tgaccgtgac taaatcaact ttaacttcta 13800
taattctgat taagctccca atttatattc ccaacggcac tacctccaaa atttatagac 13860
tctcatcccc ttttaaacca acttagtaaa cgtttttttt ttaattttat gaagttaagt 13920
ttttaccttg tttttaaaaa gaatcgttca taagatgcca tgccagaaca ttagctacac 13980
gttacacata gcatgcagcc gcggagaatt gtttttcttc gccacttgtc actcccttca 14040
aacacctaag agcttctctc tcacagcaca cacatacaat cacatgcgtg catgcattat 14100
tacacgtgat cgccatgcaa atctccttta tagcctataa attaactcat cggcttcact 14160
ctttactcaa accaaaactc atcaatacaa acaagattaa aaacatttca cgatttggaa 14220
tttgattcct gcgatcacag gtatgacagg ttagattttg ttttgtatag ttgtatacat 14280
acttctttgt gatgttttgt ttacttaatc gaatttttgg agtgttttaa ggtctctcgt 14340
ttagaaatcg tggaaaatat cactgtgtgt gtgttcttat gattcacagt gtttatgggt 14400
ttcatgttct ttgttttatc attgaatggg aagaaatttc gttgggatac aaatttctca 14460
tgttcttact gatcgttatt aggagtttgg ggaaaaagga agagtttttt tggttggttc 14520
gagtgattat gaggttattt ctgtatttga tttatgagtt aatggtcgtt ttaatgttgt 14580
agaccgccat ggctattttg aaccctgagg ctgattctgc tgctaacctc gctactgatt 14640
ctgaggctaa gcaaagacaa ttggctgagg ctggatacac tcacgttgag ggtgctcctg 14700
ctcctttgcc tttggagttg cctcacttct ctctcagaga tctcagagct gctattccta 14760
agcactgctt cgagagatct ttcgtgacct ccacctacta catgatcaag aacgtgttga 14820
cttgcgctgc tttgttctac gctgctacct tcattgatag agctggagct gctgcttatg 14880
ttttgtggcc tgtgtactgg ttcttccagg gatcttactt gactggagtg tgggttatcg 14940
ctcacgagtg tggacaccag gcttattgct cttctgaggt ggtgaacaac ttgattggac 15000
tcgtgttgca ctctgctttg ttggtgcctt accactcttg gagaatctct cacagaaagc 15060
accactccaa cactggatct tgcgagaacg atgaggtttt cgttcctgtg accagatctg 15120
tgttggcttc ttcttggaac gagaccttgg aggattctcc tctctaccaa ctctaccgta 15180
tcgtgtacat gttggttgtt ggatggatgc ctggatacct cttcttcaac gctactggac 15240
ctactaagta ctggggaaag tctaggtctc acttcaaccc ttactccgct atctatgctg 15300
atagggagag gtggatgatc gtgctctccg atattttctt ggtggctatg ttggctgttt 15360
tggctgcttt ggtgcacact ttctccttca acacgatggt gaagttctac gtggtgcctt 15420
acttcattgt gaacgcttac ttggtgttga ttacctacct ccaacacacc gatacctaca 15480
tccctcactt cagagaggga gagtggaatt ggttgagagg agctttgtgc actgtggata 15540
gatcatttgg tccattcctc gattctgtgg tgcatagaat cgtggatacc cacgtttgcc 15600
accatatctt ctccaagatg cctttctatc actgcgagga ggctaccaac gctattaagc 15660
ctctcctcgg aaagttctac ttgaaggata ctactcctgt tcctgttgct ctctggagat 15720
cttacaccca ctgcaagttc gttgaggatg atggaaaggt ggtgttctac aagaacaagt 15780
tatagttaat gaataattga ttggttcgag tattatggca ttgggaaaac tgtttttctt 15840
gtaccatttg ttgtgcttgt aatttactgt gttttttatt cggttttcgc tatcgaactg 15900
tgaaatggaa atggatggag aagagttaat gaatgatatg gtccttttgt tcattctcaa 15960
attaatatta tttgtttttt ctcttatttg ttgtgtgttg aatttgaaat tataagagat 16020
atgcaaacat tttgttttga gtaaaaatgt gtcaaatcgt ggcctctaat gaccgaagtt 16080
aatatgagga gtaaaacact tgtagttgta ccattatgct tattcactag gcaacaaata 16140
tattttcaga cctagaaaag ctgcaaatgt tactgaatac aagtatgtcc tcttgtgttt 16200
tagacattta tgaactttcc tttatgtaat tttccagaat ccttgtcaga ttctaatcat 16260
tgctttataa ttatagttat actcatggat ttgtagttga gtatgaaaat attttttaat 16320
gcattttatg acttgccaat tgattgacaa catgcatcaa tctagctagc ctcagctgac 16380
gttacgtaac gctaggtagc gtcacgtgac gttagctaac gctaggtagc gtcagctgag 16440
cttacgtaag cgcacagatg aatactagct gttgttcaca gttctagtgt ctcctcatta 16500
cgtgaattca agctacgatc actatctcaa ctcctacata aacatcagaa tgctacaaaa 16560
ctatgcacaa aaacaaaagc tacatctaat acgtgaatca attactctca tcacaagaaa 16620
gaagatttca atcaccgtcg agaaggagga ttcagttaat tgaatcaaag ttccgatcaa 16680
actcgaagac tggtgagcac gaggacgacg aagaagagtg tctcgaagat acaacaagca 16740
agaaatctac tgagtgacct cctgaagtta ttggcgcgat tgagagaatc aatccgaatt 16800
aatttcgggg aaaaagataa attagatact aagcgatggg cttgggctgg gctaagaaac 16860
aggtggcaat tgggctggag gaccccgcga ttcatagctt ccgatagccc aaaaaaaaac 16920
ggataacata tttatcgggt atttgaattt cagtgaaata agatattttc tttttgttag 16980
gaaaatttta gaaaataatg gaaattaaat agcgattatg ttacaagata cgatcagcat 17040
cgggcagtgc aaaatgctat agcttcccaa gatttgatcc ttttgggtta tctcctaatg 17100
acaattagtt taggattttg aaacttatat taatactatt atccgacaac acttgtttca 17160
gcttcttatt ttaacatttt ttgttttttt ctattcttct tcccatcagc attttctttt 17220
taaaaaattg aatactttaa ctttttaaaa atttcacaat gatcagatga tattatggaa 17280
gatctcaaga gttaaatgta tccatcttgg ggcattaaaa ccggtgtacg ggatgataaa 17340
tacagacttt atatcatatg atagctcagt aattcatatt tatcacgttg ctaaaaaaat 17400
tataaggtac tagtagtcaa caaaatcaat taaagagaaa gaaagaaacg catgtgaaga 17460
gagtttacaa ctggaaaagt aaaataaaaa ttaacgcatg ttgaatgctg acatgtcagt 17520
atgtccatga atccacgtat caagcgccat tcatcgatcg tcttcctctt tctaaatgaa 17580
aacaacttca cacatcacaa caaacaatac acacaagacc ccctctctct cgttgtctct 17640
ctgccagcga ccaaatcgaa gcttgagaag aacaagaagg ggtcaaacca tggcttctac 17700
atctgctgct caagacgctg ctccttacga gttcccttct ctcactgaga tcaagagggc 17760

tcttccttct gagtgtttcg aggcttctgt tcctctttct ctctactaca ccgctagatc 17820
tcttgctctt gctggatctc tcgctgttgc tctctcttac gctagagctt tgcctcttgt 17880
tcaggctaac gctcttcttg atgctactct ctgcactgga tacgttcttc tccagggaat 17940
cgttttctgg ggattcttca ccgttggtca cgattgtgga cacggagctt tctctagatc 18000
tcacgtgctc aacttctctg ttggaaccct catgcactct atcatcctta cccctttcga 18060
gtcttggaag ctctctcaca gacaccacca caagaacacc ggaaacatcg ataaggacga 18120
gatcttctac cctcaaagag aggctgattc tcaccctgtt tctagacacc ttgtgatgtc 18180
tcttggatct gcttggttcg cttacctttt cgctggattc cctcctagaa ccatgaacca 18240
cttcaaccct tgggaggcta tgtatgttag aagagtggct gctgtgatca tctctctcgg 18300
agttcttttc gctttcgctg gactctactc ttacctcacc ttcgttcttg gattcaccac 18360
tatggctatc tactacttcg gacctctctt catcttcgct accatgcttg ttgttaccac 18420
tttcctccac cacaacgatg aggagacacc ttggtacgct gattctgagt ggacttacgt 18480
gaagggaaac ctctcttctg tggacagatc ttacggtgct ctcatcgaca accttagcca 18540
caacatcgga actcaccaga tccaccacct cttccctatc atccctcact acaagctcaa 18600
cgatgctact gctgctttcg ctaaggcttt ccctgagctt gttaggaaaa acgctgctcc 18660
tatcatccca actttcttca ggatggctgc tatgtacgct aagtacggag ttgttgacac 18720
tgatgctaag accttcactc tcaaggaggc taaggctgct gctaagacta agtcatcttg 18780
atgattaatg aataattgat tgtacatact atatttttg tttaccttgt gttagtttaa 18840
tgttcagtgt cctctcttta ttgtggcacg tctctttgtt gtatgttgtg tctatacaaa 18900
gttgaaataa tggaaagaaa aggaagagtg taatttgttt tgttttaagt gtttataaat 18960
atatatatat aggtcattta gatagttcta ggtttctata aaactctctc tctggaagta 19020
gaatctgttt ttgagaggat ccagttgcct actaatctcc cccaaaaccc ttcaagctta 19080
accttcctct tcacaacaac agaggaaaca catctcttga gctctgagtt ctcttctttg 19140
agcatgtcta tcgctaaact catctgcctt atagcttccc tcttctcttc atctctctct 19200
ctcaccattt cgctgtaaaa cttattctcc tccctcagcc tctctatctc ttccttcagc 19260
atctcacaat tcccaccata atcgactgag gatgattcac cgtcatcaac ttcagactca 19320
gcgttgtagt cgtcatgagt ctcacaagcc ttggaccaag aagactcatc atcgcaagtt 19380
gatgatttat catgatgctt ctctgagccg tgtttgctac gtagcgtcac gtgacgttac 19440
ctaagcctag gtagcctcag ctgacgttac gtaacgctag gtaggctcag ctgactgcag 19500
caaatttaca cattgccact aaacgtctaa acccttgtaa tttgtttttg ttttactatg 19560
tgtgttatgt atttgatttg cgataaattt ttatatttgg tactaaattt ataacacctt 19620
ttatgctaac gtttgccaac acttagcaat ttgcaagttg attaattgat tctaaattat 19680
ttttgtcttc taaatacata tactaatcaa ctggaaatgt aaatatttgc taatatttct 19740
actataggag aattaaagtg agtgaatatg gtaccacaag gtttggagat ttaattgttg 19800
caatgctgca tggatggcat atacaccaaa cattcaataa ttcttgagga taataatggt 19860
accacacaag atttgaggtg catgaacgtc acgtggacaa aaggtttagt aatttttcaa 19920
gacaacaatg ttaccacaca caagttttga ggtgcatgca tggatgccct gtggaaagtt 19980
taaaaatatt ttggaaatga tttgcatgga agccatgtgt aaaaccatga catccacttg 20040
gaggatgcaa taatgaagaa aactacaaat ttacatgcaa ctagttatgc atgtagtcta 20100
tataatgagg attttgcaat actttcattc atacacactc actaagtttt acacgattat 20160
aatttcttca tagccagtac tgtttaagct tcactgtctc tgaatcggca aaggtaaacg 20220
tatcaattat tctacaaacc cttttatttt tcttttgaat taccgtcttc attggttata 20280
tgataacttg ataagtaaag cttcaataat tgaatttgat ctgtgttttt ttggccttaa 20340
tactaaatcc ttacataagc tttgttgctt ctcctcttgt gagttgagtg ttaagttgta 20400
ataatggttc actttcagct ttagaagaaa cgcgccttcc atggctacaa aggaggctta 20460
cgttttccca actctcaccg agatcaagag atctctccca aaggattgct tcgaggcttc 20520
tgtgcctttg tctctctact acactgtgag atgcttggtt attgctgtgg ctttgacctt 20580
cggattgaac tacgctagag ctttgccaga ggttgagtct ttctgggctt tggatgctgc 20640
tttgtgcact ggatatatcc tcctccaggg aattgtgttc tggggattct tcactgttgg 20700
acacgatgct ggacacggag ctttctctag ataccacctc ttgaacttcg ttgtgggaac 20760
cttcatgcac tctctcatct tgaccccatt cgagtcttgg aagttgaccc acagacacca 20820
ccacaagaac accggaaaca tcgatagaga tgaggtgttc tacccacaga gaaaggctga 20880
tgatcaccca ttgtccagga acttgatctt ggctttggga gctgcttggc ttgcttattt 20940
ggtggaggga ttcccaccaa gaaaggtgaa ccacttcaac ccattcgagc cacttttttgt 21000
gagacaagtg tccgctgtgg ttatctcttt gctcgctcac ttcttcgttg ctggactctc 21060
tatctacttg tctctccagt tgggacttaa gaccatggct atctactact acggaccagt 21120
tttcgtgttc ggatctatgt tggtgattac caccttcttg caccacaacg atgaggagac 21180
tccatggtat gctgattctg agtggactta cgtgaaggga aacttgtcct ctgtggatag 21240
atcttacggt gctctcatcg ataacctctc ccacaacatc ggaactcacc agatccacca 21300
cctcttccca attatcccac actacaagct caagaaggct actgctgctt tccaccaagc 21360
tttcccagag cttgtgagaa agtccgatga gccaatcatc aaggctttct tcagagtggg 21420
aaggttgtat gctaactacg gagtggttga tcaagaggct aagctcttca ctttgaagga 21480
ggctaaggct gctactgaag ctgctgctaa gaccaagtct acctgattaa tgaatcgaca 21540
agctcgagtt tctccataat aatgtgtgag tagttcccag ataagggaat tagggttcct 21600
atagggtttc gctcatgtgt tgagcatata agaaaccctt agtatgtatt tgtatttgta 21660
aaatacttct atcaataaaa tttctaattc ctaaaaccaa aatccagtac taaaatccag 21720
atcccccgaa ttaattcggc gttaattcag ctacgtaggc tcagctgagc ttacctaagg 21780
ctacgtaggc tcacgtgacg ttacgtaagg ctacgtagcg tcacgtgagc ttacctaact 21840

ctagctagcc tcacgtgacc ttagctaaca ctaggtagcg tcagcacaga tgaatactag 21900
ctgttgttca cagttctagt gtctcctcat tacgtgaatt caagctacga tcactatctc 21960
aactcctaca taaacatcag aatgctacaa aactatgcac aaaaacaaaa gctacatcta 22020
atacgtgaat caattactct catcacaaga aagaagattt caatcaccgt cgagaaggag 22080
gattcagtta attgaatcaa agttccgatc aaactcgaag actggtgagc acgaggacga 22140
cgaagaagag tgtctcgaag atacaacaag caagaaatct actgagtgac ctcctgaagt 22200
tattggcgcg attgagagaa tcaatccgaa ttaatttcgg ggaaaaagat aaattagata 22260
ctaagcgatg ggcttgggct gggctaagaa acaggtggca attgggctgg aggaccccgc 22320
gattcatagc ttccgatagc ccaaaaaaaa acggataaca tatttatcgg gtatttgaat 22380
ttcagtgaaa taagatattt tctttttgtt aggaaaattt tagaaaataa tggaaattaa 22440
atagcgatta tgttacaaga tacgatcagc atcgggcagt gcaaaatgct atagcttccc 22500
aagatttgat ccttttgggt tatctcctaa tgacaattag tttaggattt tgaaacttat 22560
attaatacta ttatccgaca acacttgttt cagcttctta ttttaacatt ttttgttttt 22620
ttctattctt cttcccatca gcattttctt tttaaaaaat tgaatacttt aactttttaa 22680
aaatttcaca atgatcagat gatattatgg aagatctcaa gagttaaatg tatccatctt 22740
ggggcattaa aaccggtgta cgggatgata aatacagact ttatatcata tgatagctca 22800
gtaattcata tttatcacgt tgctaaaaaa attataaggt actagtagtc aacaaaatca 22860
attaaagaga aagaaagaaa cgcatgtgaa gagagtttac aactggaaaa gtaaaataaa 22920
aattaacgca tgttgaatgc tgacatgtca gtatgtccat gaatccacgt atcaagcgcc 22980
attcatcgat cgtcttcctc tttctaaatg aaaacaactt cacacatcac aacaaacaat 23040
acacacaaga ccccctctct ctcgttgtct ctctgccagc gaccaaatcg aagcttgaga 23100
agaacaagaa ggggtcaaac catgggaaaa ggatctgagg gaagatctgc tgctagagag 23160
atgactgctg aggctaacgg agataagaga aagaccatcc tcattgaggg agtgttgtac 23220
gatgctacca acttcaaaca cccaggaggt tccattatta acttcctcac cgagggagaa 23280
gctggagttg atgctaccca agcttacaga gagttccatc agagatccgg aaaggctgat 23340
aagtacctca agtccctccc aaagttggat gcttctaagg tggagtctag gttctctgct 23400
aaggagcagg ctagaaggga cgctatgacc agggattacg ctgctttcag agaggagttg 23460
gttgctgagg gatacttcga tccatctatc ccacacatga tctacagagt ggtggagatt 23520
gtggctttgt tcgctttgtc tttctggttg atgtctaagg cttctccaac ctctttggtt 23580
ttgggagtgg tgatgaacgg aatcgctcaa ggaagatgcg gatgggttat gcacgagatg 23640
ggacacggat ctttcactgg agttatctgg ctcgatgata ggatgtgcga gttcttctac 23700
ggagttggat gtggaatgtc tggacactac tggaagaacc agcactctaa gcaccacgct 23760
gctccaaaca gattggagca cgatgtggat ttgaacacct tgccactcgt tgctttcaac 23820
gagagagttg tgaggaaggt taagccagga tctttgttgg ctttgtggct cagagttcag 23880
gcttatttgt tcgctccagt gtcttgcttg ttgatcggat tgggatggac cttgtacttg 23940
cacccaagat atatgctcag gaccaagaga cacatggagt ttgtgtggat cttcgctaga 24000
tatatcggat ggttctcctt gatgggagct ttgggatatt ctcctggaac ttctgtggga 24060
atgtacctct gctctttcgg acttggatgc atctacatct tcctccaatt cgctgtgtct 24120
cacacccact tgccagttac caacccagag gatcaattgc actggcttga gtacgctgct 24180
gatcacaccg tgaacatctc taccaagtct tggttggtta cctggtggat gtctaacctc 24240
aacttccaaa tcgagcacca cttgttccca accgctccac aattcaggtt caaggagatc 24300
tctccaagag ttgaggctct cttcaagaga cacaacctcc cttactacga tttgccatac 24360
acctctgctg tttctactac cttcgctaac ctctactctg ttggacactc tgttggagct 24420
gataccaaga agcaggattg atgattaatg aataattgat tgtacatact atattttttg 24480
tttaccttgt gttagtttaa tgttcagtgt cctctcttta ttgtggcacg tctctttgtt 24540
gtatgttgtg tctatacaaa gttgaaataa tggaaagaaa aggaagagtg taatttgttt 24600
tgttttaagt gtttataaat atatatatat aggtcattta gatagttcta ggtttctata 24660
aaactctctc tctggaagta gaatctgttt ttgagaggat ccagttgcct actaatctcc 24720
cccaaaaccc ttcaagctta accttcctct tcacaacaac agaggaaaca catctcttga 24780
gctctgagtt ctcttctttg agcatgtcta tcgctaaact catctgcctt atagcttccc 24840
tcttctcttc atctctctct ctcaccattt cgctgtaaaa cttattctcc tccctcagcc 24900
tctctatctc ttccttcagc atctcacaat tcccaccata atcgactgag gatgattcac 24960
cgtcatcaac ttcagactca gcgttgtagt cgtcatgagt ctcacaagcc ttggaccaag 25020
aagactcatc atcgcaagtt gatgatttat catgatgctt ctctgagccg tgtttgctac 25080
ctagagtcag ctgagcttag ctaacgctag ctagtgtcag ctgacgttac gtaaggctaa 25140
ctagcgtcac gtgaccttac gtaacgctac gtaggctcag ctgagcttag ctaaccctag 25200
ctagtgtcac gtgagcttac gctactatag aaaatgtgtt atatcgacat gaccagacaa 25260
aggggcaaca gttaacaaaa caattaattc tttcatttga gattaaggaa ggtaaggtac 25320
taaaaagatt aaaaaaaatg agcttatctc tttgtttctg taataataat ataagtgtga 25380
taaactttta atataataat tgtaattagg ttttctacag atgagcacca ctcagagaca 25440
agataagaag aaaacaattt tgttaaacat gattatagaa acttttagtt aagtcttgaa 25500
gtatcaatat aacaaaaaaa agtacacacg actatgacaa taaacccact accgtcaggt 25560
tatcatttcg atgaaatgtt ttgatatcat taaatataac agtcacaaaa aatcatctaa 25620
ttataacaat ataacttata catatattta actaaaaact tagagttttt gtaatgattc 25680
taattgatga ttagagttta tagaaataca attaaataaa aaatataatt ttaaaaaaac 25740
atagtaaagt caatgagatc ctctctgacc tcagtgatca tttagtcatg tatgtacaac 25800
aatcattgtt catcacatga ctgtaaaata aataaggata aacttgggaa tatatataat 25860
atattgtatt aaataaaaaa gggaaataca aatatcaatt ttagattccc gagttgacac 25920

aactcaccat gcacgctgcc acctcagctc ccagctctcg tcacatgtct catgtcagtt 25980
aggtctttgg tttttagtct ttgacacaac tcgccatgca tgttgccacg tgagctcgtt 26040
cctcttccca tgatctcacc actgggcatg catgctgcca cctcagctgg cacctcttct 26100
ctatatgtcc ctagaggcca tgcacagtgc cacctcagca ctcctctcag aacccatacg 26160
tacctgccaa tcggcttctc tccataaata tctatttaaa ttataactaa ttatttcata 26220
tacttaattg atgacgtgga tgcattgcca tcgttgttta ataattgtta attacgacat 26280
gataaataaa atgaaagtaa aaagtacgaa agattttcca tttgttgttg tataaataga 26340
gaagtgagtg atgcataatg catgaatgca tgaccgcgcc accatgactg ttggatacga 26400
cgaggagatc ccattcgagc aagttagggc tcataacaag ccagacgacg cttggtgtgc 26460
tattcacgga cacgtgtacg acgttaccaa gttcgcttca gttcacccag gaggagatat 26520
tatcttgctc gctgctggaa aggaagctac tgtcctctac gagacctacc atgttagagg 26580
agtgtctgac gctgtgctca gaaagtacag aataggaaag ttgccagacg gacaaggagg 26640
agctaacgag aaggagaaga gaaccttgtc tggattgtcc tctgcttctt actacacctg 26700
gaactccgat ttctacagag tgatgaggga gagagttgtg gctagattga aggagagagg 26760
aaaggctaga agaggaggat acgaactctg gatcaaggct ttcttgctcc ttgttggatt 26820
ctggtcctct ctttactgga tgtgcaccct cgatccatct ttcggagcta tcttggctgc 26880
tatgtctttg ggagtgttcg ctgcttttgt tggaacctgc atccaacacg atggaaacca 26940
cggagctttc gctcaatcta gatgggttaa caaggtggca ggatggactt tggatatgat 27000
cggagcttct ggaatgactt gggagttcca acacgtgttg ggacaccacc catacactaa 27060
cttgatcgag gaggagaacg gattgcaaaa ggtgtccgga aagaagatgg ataccaagtt 27120
ggctgatcaa gagtctgatc cagatgtgtt ctccacctac ccaatgatga gattgcaccc 27180
ttggcaccag aagaggtggt atcacaggtt ccagcacatc tacggacctt tcatcttcgg 27240
attcatgacc atcaacaagg tggtgactca agatgttgga gtggtgttga gaaagagact 27300
cttccaaatc gatgctgagt gcagatatgc ttccccaatg tacgttgcta ggttctggat 27360
tatgaaggct ttgaccgtgt tgtatatggt tgctttgcct tgttatatgc aaggaccttg 27420
gcacggattg aaactcttcg ctatcgctca cttcacttgc ggagaggttt tggctaccat 27480
gttcatcgtg aaccacatta tcgagggagt gtcttacgct tctaaggatg ctgttaaggg 27540
aactatggct ccaccaaaga ctatgcacgg agtgacccca atgaacaaca ctagaaagga 27600
ggttgaggct gaggcttcta agtctggagc tgtggttaag tctgtgccat tggatgattg 27660
ggctgctgtt cagtgccaaa cctctgtgaa ctggtctgtt ggatcttggt tttggaacca 27720
cttctctgga ggactcaacc accaaatcga gcaccacctc ttcccaggat tgtctcacga 27780
gacctactac cacatccaag acgtggttca atctacctgt gctgagtacg gagttccata 27840
ccaacacgag ccatctttgt ggactgctta ctggaagatg ctcgaacacc ttagacaatt 27900
gggaaacgag gagactcacg agtcatggca gagagctgct tgattaatga actaagactc 27960
ccaaaaccac cttccctgtg acagttaaac cctgcttata cctttcctcc taataatgtt 28020
catctgtcac acaaactaaa ataaataaaa tgggagcaat aaataaaatg ggagctcata 28080
tatttacacc atttacactg tctattattc accatgccaa ttattacttc ataattttaa 28140
aattatgtca tttttaaaaa ttgcttaatg atggaaagga ttattataag ttaaaagtat 28200
aacatagata aactaaccac aaaacaaatc aatataaact aacttactct cccatctaat 28260
ttttatttaa atttctttac acttctcttc catttctatt tctacaacat tatttaacat 28320
ttttattgta tttttcttac tttctaactc tattcatttc aaaaatcaat atatgtttat 28380
caccacctct ctaaaaaaaa ctttacaatc attggtccag aaaagttaaa tcacgagatg 28440
gtcattttag cattaaaaca acgattcttg tatcactatt tttcagcatg tagtccattc 28500
tcttcaaaca aagacagcgg ctatataatc gttgtgttat attcagtcta aaacaactag 28560
ctagcctcag ctgacgttac gtaacgctag gtagcgtcac gtgacgttag ctaacgctag 28620
gtagcgtcag ctgagcttac gtaagcgcca cgggcaggac atagggacta ctacaagcat 28680
agtatgcttc agacaaagag ctaggaaaga actcttgatg gaggttaaga gaaaaaagtg 28740
ctagaggggc atagtaatca aacttgtcaa aaccgtcatc atgatgaggg atgacataat 28800
ataaaaagtt gactaaggtc ttggtagtac tctttgatta gtattatata ttggtgagaa 28860
catgagtcaa gaggagacaa gaaaccgagg aaccatagtt tagcaacaag atggaagttg 28920
caaagttgag ctagccgctc gattagttac atctcctaag cagtactaca aggaatggtc 28980
tctatacttt catgtttagc acatggtagt gcggattgac aagttagaaa cagtgcttag 29040
gagacaaaga gtcagtaaag gtattgaaag agtgaagttg atgctcgaca ggtcaggaga 29100
agtccctccg ccagatggtg actaccaagg ggttggtatc agctgagacc caaataagat 29160
tcttcggttg aaccagtggt tcgaccgaga ctcttagggt gggatttcac tgtaagattt 29220
gtgcattttg ttgaatataa attgacaatt ttttttattt aattatagat tatttagaat 29280
gaattacata tttagtttct aacaaggata gcaatggatg ggtatgggta caggttaaac 29340
atatctatta cccacccatc tagtcgtcgg gttttacacg tacccacccg tttacataaa 29400
ccagaccgga attttaaacc gtacccgtcc gttagcgggt ttcagattta cccgtttaat 29460
cgggtaaaac ctgattacta aatatatatt ttttatttga taaacaaaac aaaaatgtta 29520
atattttcat attggatgca attttaagaa acacatattc ataaatttcc atatttgtag 29580
gaaaataaaa agaaaaatat attcaagaac acaaatttca ccgacatgac ttttattaca 29640
gagttggaat tagatctaac aattgaaaaa ttaaaattaa gatagaatat gttgaggaac 29700
atgacatagt ataatgctgg gttacccgtc gggtaggtat cgaggcggat actactaaat 29760
ccatcccact cgctatccga taatcactgg tttcgggtat acccattccc gtcaacaggc 29820
ctttttaacc ggataatttc aacttatagt gaatgaattt tgaataaata gttagaatac 29880
caaaatcctg gattgcattt gcaatcaaat tttgtgaacc gttaaatttt gcatgtactt 29940
gggatagata taatagaacc gaattttcat tagtttaatt tataacttac tttgttcaaa 30000

```
gaaaaaaaat atctatccaa tttacttata ataaaaaata atctatccaa gttacttatt  30060
ataatcaact tgtaaaaagg taagaataca aatgtggtag cgtacgtgtg attatatgtg  30120
acgaaatgtt atatctaaca aaagtccaaa ttcccatggt aaaaaaaatc aaaatgcatg  30180
gcaggctgtt tgtaaccttg gaataagatg ttggccaatt ctggagccgc cacgtacgca  30240
agactcaggg ccacgttctc ttcatgcaag gatagtagaa caccactcca cccacctcct  30300
atattagacc tttgcccaac cctccccaac tttcccatcc catccacaaa gaaaccgaca  30360
tttttatcat aaatcagggt ttcgtttttg tttcatcgat aaactcaaag gtgatgattt  30420
tagggtcttg tgagtgtgct tttttgtttg attctactgt agggtttatg ttctttagct  30480
cataggtttt gtgtatttct tagaaatgtg gcttctttaa tctctgggtt tgtgactttt  30540
tgtgtggttt ctgtgttttt catatcaaaa acctattttt tccgagtttt tttttacaaa  30600
ttcttactct caagcttgaa tacttcacat gcagtgttct tttgtagatt ttagagttaa  30660
tgtgttaaaa agtttggatt tttcttgctt atagagcttc ttcactttga ttttgtgggt  30720
ttttttgttt taaaggtgag atttttgatg aggtttttgc ttcaaagatg tcacctttct  30780
gggtttgtct tttgaataaa gctatgaact gtcacatggc tgacgcaatt ttgttactat  30840
gtcatgaaag ctgacgtttt tccgtgttat acatgtttgc ttacacttgc atgcgtcaaa  30900
aaaattgggg ctttttagtt ttagtcaaag attttacttc tcttttggga tttatgaagg  30960
aaagttgcaa actttctcaa attttaccat ttttgctttg atgtttgttt agattgcgac  31020
agaacaaact catatatgtt gaaatttttg cttggttttg tataggattg tgtcttttgc  31080
ttataaatgt tgaaatctga actttttttt tgtttggttt ctttgagcag gagataaggc  31140
gcaccaccat ggcttctaca tctgctgctc aagacgctgc tccttacgag ttcccttctc  31200
tcactgagat caagagggct cttccttctg agtgtttcga ggcttctgtt cctctttctc  31260
tctactacac cgctagatct cttgctcttg ctggatctct cgctgttgct ctctcttacg  31320
ctagagcttt gcctcttgtt caggctaacg ctcttcttga tgctactctc tgcactggat  31380
acgttcttct ccagggaatc gttttctggg gattcttcac cgttggtcac gattgtggac  31440
acggagcttt ctctagatct cacgtgctca acttctctgt tggaaccctc atgcactcta  31500
tcatccttac ccctttcgag tcttggaagc tctctcacag acaccaccac aagaacaccg  31560
gaaacatcga taaggacgag atcttctacc ctcaaagaga ggctgattct caccctgttt  31620
ctagacacct tgtgatgtct cttggatctg cttggttcgc ttaccttttc gctggattcc  31680
ctcctagaac catgaaccac ttcaacccct gggaggctat gtatgttaga agagtggctg  31740
ctgtgatcat ctctctcgga gttcttttcg ctttcgctgg actctactct tacctcacct  31800
tcgttcttgg attcaccact atggctatct actacttcgg acctctcttc atcttcgcta  31860
ccatgcttgt tgttaccact ttcctccacc acaacgatga ggagacacct tggtacgctg  31920
attctgagtg gacttacgtg aagggaaacc tctcttctgt ggacagatct tacggtgctc  31980
tcatcgacaa ccttagccac aacatcggaa ctcaccagat ccaccacctc ttccctatca  32040
tccctcacta caagctcaac gatgctactg ctgctttcgc taaggctttc cctgagcttg  32100
ttaggaaaaa cgctgctcct atcatcccaa ctttcttcag gatggctgct atgtacgcta  32160
agtacggagt tgttgacact gatgctaaga ccttcactct caaggaggct aaggctgctg  32220
ctaagactaa gtcatcttga tgattaatga aggccgcaga tatcagatct ggtcgaccta  32280
gaggatcccc ggccgcaaag ataataacaa aagcctacta tataacgtac atgcaagtat  32340
tgtatgatat taatgttttt acgtacgtgt aaacaaaaat aattacgttt gtaacgtatg  32400
gtgatgatgt ggtgcactag gtgtaggcct tgtattaata aaaagaagtt tgttctatat  32460
agagtggttt agtacgacga tttatttact agtcggattg gaatagagaa ccgaattctt  32520
caatccttgc ttttgatcaa gaattgaaac cgaatcaaat gtaaaagttg atatatttga  32580
aaaacgtatt gagcttatga aaatgctaat actctcatct gtatggaaaa gtgactttaa  32640
aaccgaactt aaaagtgaca aaaggggaat atcgcatcaa accgaatgaa accgatctac  32700
gtaggctcag ctgagcttac ctaaggctac gtaggctcac gtgacgttac gtaaggctac  32760
gtagcgtcac gtgagcttac ctaactctag ctagcctcac gtgaccttag ctaacactag  32820
gtagcgtcag cttagcagat atttggtgtc taaatgttta ttttgtgata tgttcatgtt  32880
tgaaatggtg gtttcgaaac cagggacaac gttgggatct gatagggtgt caaagagtat  32940
tatggattgg gacaatttcg gtcatgagtt gcaaattcaa gtatatcgtt cgattatgaa  33000
aattttcgaa gaatatccca tttgagagag tctttacctc attaatgttt ttagattatg  33060
aaattttatc atagttcatc gtagtctttt tggtgtaaag gctgtaaaaa gaaattgttc  33120
acttttgttt tcgtttatgt gaaggctgta aaagattgta aaagactatt ttggtgtttt  33180
ggataaaatg atagttttta tagattcttt tgcttttaga agaaatacat ttgaaatttt  33240
ttccatgttg agtataaaat accgaaatcg attgaagatc atagaaatat tttaactgaa  33300
aacaaattta taactgattc aattctctcc atttttatac ctatttaacc gtaatcgatt  33360
ctaatagatg atcgattttt tatataatcc taattaacca acggcatgta ttggataatt  33420
aaccgatcaa ctctcacccc taatagaatc agtattttcc ttcgacgtta attgatccta  33480
cactatgtag gtcatatcca tcgttttaat ttttggccac cattcaattc tgtcttgcct  33540
ttagggatgt gaatatgaac ggccaaggta agagaataaa aataatccaa attaaagcaa  33600
gagaggccaa gtaagataat ccaaatgtac acttgtcatt gccaaaatta gtaaaatact  33660
cggcatattg tattcccaca cattattaaa ataccgtata tgtattggct gcatttgcat  33720
gaataatact acgtgtaagc ccaaaagaac ccacgtgtag cccatgcaaa gttaacactc  33780
acgaccccat tcctcagtct ccactatata aacccaccat ccccaatctc accaaaccca  33840
ccacacaact cacaactcac tctcacacct taaagaacca atcaccacca aaaaaagttc  33900
tttgctttcg aagttgccgc aacctaaaca ggtttttcct tcttctttct tcttattaac  33960
tacgaccttg tcctttgcct atgtaaaatt actaggtttt catcagttac actgattaag  34020
ttcgttatag tggaagataa aatgccctca aagcatttg caggatatct ttgattttc   34080
```

aaagatatgg aactgtagag tttgatagtg ttcttgaatg tggttgcatg aagttttttt 34140
ggtctgcatg ttatttttc ctcgaaatat gttttgagtc caacaagtga ttcacttggg 34200
attcagaaag ttgttttctc aatatgtaac agttttttc tatggagaaa aatcataggg 34260
accgttggtt ttggcttctt taattttgag ctcagattaa acccatttta cccggtgttc 34320
ttggcagaat tgaaaacagt acgtagtacc gcgcctacca tgccacctag tgctgctagt 34380
gaaggtggtg ttgctgaact tagagctgct gaagttgcta gctacactag aaaggctgtt 34440
gacgaaagac ctgacctcac tatagttggt gacgctgttt acgacgctaa ggcttttagg 34500
gacgagcacc ctggtggtgc tcacttcgtt agccttttcg gaggtaggga cgctactgag 34560
gcttttatgg aatatcaccg tagagcttgg cctaaggcta ggatgtctaa gttcttcgtt 34620
ggttcacttg acgctagcga gaagcctact caagctgatt cagcttacct tagactttgc 34680
gctgaggtta acgctctttt gcctaagggt agcggaggat tcgctcctcc tagctactgg 34740
cttaaggctg ctgctcttgt tgttgctgct gttagtatag agggttatat gctccttagg 34800
ggtaagaccc ttttgcttag cgttttcctt ggactcgtgt tcgcttggat aggacttaat 34860
attcagcacg acgctaatca cggtgctctt agtagacact cagtgattaa ctactgcctc 34920
ggttacgctc aggattggat aggtggtaat atggtgcttt ggcttcaaga gcacgttgtg 34980
atgcaccacc tccacactaa cgacgttgac gctgatcctg atcaaaaggc tcacggtgtt 35040
cttagactta agcctactga cggttggatg ccttggcacg cacttcaaca actctatatc 35100
cttcctggtg aggctatgta cgcttttaag cttcttttct tggacgccct tgagcttctt 35160
gcttggaggt gggagggtga gaagattagc cctcttgcta gagctttgtt cgctcctgct 35220
gttgcttgta agcttggatt ctgggctaga ttcgttgctc tccctctctg gcttcaacct 35280
actgttcaca ctgctttgtg tatctgtgct actgtgtgta ctggtagctt ctacctcgcc 35340
ttcttcttct ttatctctca caacttcgac ggtgttggta gcgttggacc taagggatca 35400
cttcctagat cagctacttt cgttcaacgt caggttgaga ctagctctaa cgttggtggt 35460
tactggcttg gagttcttaa cggtggactt aactttcaga tagagcacca cttgttccct 35520
aggcttcacc actcttacta cgctcaaata gctcctgtgg ttaggactca catagagaag 35580
ctcggtttta agtaccgtca cttccctacc gttggatcta accttagctc aatgcttcag 35640
catatgggta agatgggaac tagacctggt gctgagaagg gtggtaaggc tgagtagtga 35700
ttaatgaata attgattgct gctttaatga gatatgcgag acgcctatga tcgcatgata 35760
tttgctttca attctgttgt gcacgttgta aaaaacctga gcatgtgtag ctcagatcct 35820
taccgccggt ttcggttcat tctaatgaat atatcacccg ttactatcgt atttttatga 35880
ataatattct ccgttcaatt tactgattgt ctacgtagcg tcacctgacg ttacgtaagg 35940
ctacctaggc tcacgtgacg ttacgtaacg ctacgtagcg tcaggtgagg ttagctaacg 36000
ctagctagcc tcacctgacg ttaggtaagg ctacgtagcg tcacctgaga ttagctaagc 36060
ctacctagac tcacgtgacc ttaggtaacg ctacgtagcg tcaaagcttt acaacgctac 36120
acaaaactta taaccgtaat caccattcat taacttaact actatcacat gcattcatga 36180
attgaaacga gaaggatgta aatagttggg aagttatctc cacgttgaag agatcgttag 36240
cgagagctga aagaccgagg gaggagacgc cgtcaacacg gacagagtcg tcgaccctca 36300
catgaagtag gaggaatctc cgtgaggagc cagagagacg tctttggtct tcggtttcga 36360
tccttgatct gacggagaag acgagagaag tgcgactgga ctccgtgagg accaacagag 36420
tcgtcctcgg tttcgatcgt cggtattggt ggagaaggcg gaggaatctc cgtgacgagc 36480
cagagagatg tcgtcggtct tcggtttcga tccttgatct gacggagaag acgagagaag 36540
tgcgacgaga ctccgtgagg accaacagag ttgtcctcgg tttcgatcgt cggtttcggc 36600
ggagaaggcg gaggaatctc cgtgaggagc cagagagacg tcgttggtct tcggtttcga 36660
tccttgatct gttggagaag acgagacaag tgggacgaga ctcaacgacg gagtcagaga 36720
cgtcgtcggt cttcggtttc ggccgagaag gcggagtcgg tcttcggttt cggccgagaa 36780
ggcggaggag acgtcttcga tttgggtctc tcctcttgac gaagaaaaca aagaacacga 36840
gaaataatga gaaagagaac aaaagaaaaa aaaataaaaa taaaaataaa atttggtcct 36900
cttatgtggt gacacgtggt ttgaaaccca ccaaataatc gatcacaaaa aacctaagtt 36960
aaggatcggt aataaccttt ctaattaatt ttgatttata ttaaatcact ctttttattt 37020
ataaacccca ctaaattatg cgatattgat tgtctaagta caaaaattct ctcgaattca 37080
atacacatgt ttcatatatt tagccctgtt catttaatat tactagcgca tttttaattt 37140
aaaattttgt aaactttttt ggtcaaagaa cattttttta attagagaca gaaatctaga 37200
ctctttattt ggaataatag taataaagat atattaggca atgagtttat gatgttatgt 37260
ttatatagtt tatttcattt taaattgaaa agcattattt ttatcgaaat gaatctagta 37320
tacaatcaat atttatgttt tttcatcaga tactttccta tttttggca cctttcatcg 37380
gactactgat ttatttcaat gtgtatgcat gcatgagcat gagtatacac atgtctttta 37440
aaatgcatgt aaagcgtaac ggaccacaaa agaggatcca tacaaataca tctcatcgct 37500
tcctctacta ttctccgaca cacacactga gcatggtgct taaacactct ggtgagttct 37560
agtacttctg ctatgatcga tctcattacc atttcttaaa tttctctccc taaatattcc 37620
gagttcttga tttttgataa cttcaggttt tctcttttg ataaatctgg tctttccatt 37680
tttttttttt tgtggttaat ttagtttcct atgttcttcg attgtattat gcatgatctg 37740
tgtttggatt ctgttagatt atgtattggt gaatatgtat gtgtttttgc atgtctggtt 37800
ttggtcttaa aaatgttcaa atctgatgat ttgattgaag ctttttagt gttggtttga 37860
ttcttctcaa aactactgtt aatttactat catgttttcc aactttgatt catgatgaca 37920
cttttgttct gctttgttat aaaattttgg ttggtttgat tttgtaatta tagtgtaatt 37980
ttgttaggaa tgaacatgtt ttaatactct gttttcgatt tgtcacacat tcgaattatt 38040
aatcgataat ttaactgaaa attcatggtt ctagatcttg ttgtcatcag attatttgtt 38100
tcgataattc atcaaatatg tagtcctttt gctgatttgc gactgtttca ttttttctca 38160

aaattgtttt ttgttaagtt tatctaacag ttatcgttgt caaaagtctc tttcattttg 38220
caaaatcttc tttttttttt tgtttgtaac tttgtttttt aagctacaca tttagtctgt 38280
aaaatagcat cgaggaacag ttgtcttagt agacttgcat gttcttgtaa cttctatttg 38340
tttcagtttg ttgatgactg ctttgatttt gtaggtcaaa ccgcgccatg tctgctagcg 38400
gagctttgtt gcctgctata gctttcgctg cttacgctta cgctacctac gcttatgctt 38460
tcgagtggag ccacgctaac ggaatcgata acgtggatgc tagagagtgg attggagctt 38520
tgtctttgag actccctgca attgcaacca caatgtacct cttgttctgc cttgtgggac 38580
ctagattgat ggctaagagg gaggcttttg atcctaaggg atttatgctc gcttacaacg 38640
cttaccaaac cgctttcaac gttgtggtgc tcggaatgtt cgctagagag atctctggat 38700
tgggacaacc tgtttgggga tctactatgc cttggagcga taggaagtcc ttcaagattt 38760
tgttgggagt gtggctccac tacaacaata agtacctcga gttgttggat actgtgttca 38820
tggtggctag gaaaaagacc aagcagctct ctttcttgca cgtgtaccac cacgctttgt 38880
tgatttgggc ttggtggctt gtttgtcacc tcatggctac caacgattgc atcgatgctt 38940
atttcggagc tgcttgcaac tctttcatcc acatcgtgat gtactcctac tacctcatgt 39000
ctgctttggg aattaggtgc ccttggaaga gatatatcac ccaggctcag atgttgcaat 39060
tcgtgatcgt gttcgctcac gctgttttcg tgctcagaca aaagcactgc cctgttactt 39120
tgccttgggc acaaatgttc gtgatgacaa atatgttggt gctcttcgga aacttctacc 39180
tcaaggctta ctctaacaag tctaggggag atggagcttc ttctgttaag cctgctgaga 39240
ctactagagc accttctgtg agaagaacca ggtcaaggaa gatcgattga tagttaatga 39300
actaagtttg atgtatctga gtgccaacgt ttactttgtc tttcctttct tttattggtt 39360
atgattagat gtttactatg ttctctcttt ttcgttataa ataaagaagt tcaattcttc 39420
tatagtttca aacgcgattt taagcgtttc tatttaggtt tacatgattt cttttacaaa 39480
atcatcttta aaatacagta tattttagt tttcataaaa tatttaaaga aatgaaagtt 39540
tataaacatt cactcctatt ctctaattaa ggatttgtaa aacaaaaatt ttgtaagcat 39600
atcgatttat gcgttttgtc ttaattagct cactaaataa taaataatag cttatgttgt 39660
gggactgttt aattacctaa cttagaacta aaatcaactc tttgtgctag ctagcctcag 39720
ctgacgttac gtaacgctag gtagcgtcac gtgacgttag ctaacgctag gtagcgtcag 39780
ctgagcttac gtaagcgctt aattaaagta ctgatatcgg taccaaatcg aatccaaaaa 39840
ttacggatat gaatataggc atatccgtat ccgaattatc cgtttgacag ctagcaacga 39900
ttgtacaatt gcttctttaa aaaaggaaga aagaaagaaa gaaaagaatc aacatcagcg 39960
ttaacaaacg gccccgttac ggcccaaacg gtcatataga gtaacggcgt taagcgttga 40020
aagactccta tcgaaatacg taaccgcaaa cgtgtcatag tcagatcccc tcttccttca 40080
ccgcctcaaa cacaaaaata atcttctaca gcctatatat acaacccccc cttctatctc 40140
tcctttctca caattcatca tctttctttc tctacccca atttaagaa atcctctctt 40200
ctcctcttca ttttcaaggt aaatctctct ctctctctct ctctctgtta ttccttgttt 40260
taattaggta tgtattattg ctagtttgtt aatctgctta tcttatgtat gccttatgtg 40320
aatatcttta tcttgttcat ctcatccgtt tagaagctat aaatttgttg atttgactgt 40380
gtatctacac gtggttatgt ttatatctaa tcagatatga atttcttcat attgttgcgt 40440
ttgtgtgtac caatccgaaa tcgttgattt ttttcattta atcgtgtagc taattgtacg 40500
tatacatatg gatctacgta tcaattgttc atctgtttgt gtttgtatgt atacagatct 40560
gaaaacatca cttctctcat ctgattgtgt tgttacatac atagatatag atctgttata 40620
tcattttttt tattaattgt gtatatatat atgtgcatag atctggatta catgattgtg 40680
attatttaca tgattttgtt atttacgtat gtatatatgt agatctggac tttttggagt 40740
tgttgacttg attgtatttg tgtgtgtata tgtgtgttct gatcttgata tgttatgtat 40800
gtgcagctga accatggcgg cggcaacaac aacaacaaca acatcttctt cgatctcctt 40860
ctccaccaaa ccatctcctt cctcctccaa atcaccatta ccaatctcca gattctccct 40920
cccattctcc ctaaacccca acaaatcatc ctcctcctcc cgccgccgcg gtatcaaatc 40980
cagctctccc tcctccatct ccgccgtgct caacacaacc accaatgtca caaccactcc 41040
ctctccaacc aaacctacca aacccgaaac attcatctcc cgattcgctc cagatcaacc 41100
ccgcaaaggc gctgatatcc tcgtcgaggc tttagaacgt caaggcgtag aaaccgtatt 41160
cgcttaccct ggaggtacat caatggagat tcaccaagcc ttaacccgct cttcctcaat 41220
ccgtaacgtc cttcctcgtc acgaacaagg aggtgtattc gcagcagaag gatacgctcg 41280
atcctcaggt aaaccaggta tctgtatagc cacttcaggt cccggagcta caaatctcgt 41340
tagcggatta gccgatgcgt tgttagatag tgttcctctt gtagcaatca caggacaagt 41400
ccctcgtcgt atgattggta cagatgcgtt tcaagagact ccgattgttg aggtaacgcg 41460
ttcgattacg aagcataact atcttgtgat ggatgttgaa gatatcccaa ggattattga 41520
agaggctttc tttttagcta cttctggtag acctggacct gttttggttg atgttcctaa 41580
agatattcaa caacagcttg cgattcctaa ttgggaacag gctatgagat tacctggtta 41640
tatgtctagg atgcctaaac ctccggaaga ttctcatttg gagcagattg ttaggttgat 41700
ttctgagtct aagaagcctg tgttgtatgt tggtggtggt tgtcttaatt ctagcgatga 41760
attgggtagg tttgttgagc ttacgggcat ccctgttgcg agtacgttga tggggctggg 41820
atcttatcct tgtgatgatg agttgtcgtt acatatgctt ggaatgcatg ggactgtgta 41880
tgcaaattac gctgtggagc atagtgattt gttgttggcg tttggggtaa ggtttgatga 41940
tcgtgtcacg ggtaaacttg aggcttttgc tagtagggct aagattgttc atattgatat 42000
tgactcggct gagattggga agaataagac tcctcatgtg tctgtgtgtg gtgatgttaa 42060
gctggctttg caagggatga ataaggttct tgagaaccga gcggaggagc ttaaacttga 42120
ttttggagtt tggaggaatg agttgaacgt acagaaacag aagtttccgt tgagctttaa 42180
gacgtttggg gaagctattc ctccacagta tgcgattaag gtccttgatg agttgactga 42240

tggaaaagcc ataataagta ctggtgtcgg gcaacatcaa atgtgggcgg cgcagttcta 42300
caattacaag aaaccaaggc agtggctatc atcaggaggc cttggagcta tgggatttgg 42360
acttcctgct gcgattggag cgtctgttgc taaccctgat gcgatagttg tggatattga 42420
cggagatgga agttttataa tgaatgtgca agagctagcc actattcgtg tagagaatct 42480
tccagtgaag gtacttttat taaacaacca gcatcttggc atggttatgc aatgggaaga 42540
tcggttctac aaagctaacc gagctcacac atttctcggg gacccggctc aggaggacga 42600
gatattcccg aacatgttgc tgtttgcagc agcttgcggg attccagcgg cgagggtgac 42660
aaagaaagca gatctccgag aagctattca gacaatgctg gatacaccag gaccttacct 42720
gttggatgtg atttgtccgc accaagaaca tgtgttgccg atgatcccga atggtggcac 42780
tttcaacgat gtcataacgg aaggagatgg ccggattaaa tactgagaga tgaaaccggt 42840
gattatcaga acctttatg gtctttgtat gcatatggta aaaaaactta gtttgcaatt 42900
tcctgtttgt tttggtaatt tgagtttctt ttagttgttg atctgcctgc tttttggttt 42960
acgtcagact actactgctg ttgttgtttg gtttcctttc tttcatttta taaataaata 43020
atccggttcg gtttactcct tgtgactggc tcagtttggt tattgcgaaa tgcgaatggt 43080
aaattgagta attgaaattc gttattaggg ttctaagctg ttttaacagt cactgggtta 43140
atatctctcg aatcttgcat ggaaaatgct cttaccattg gtttttaatt gaaatgtgct 43200
catatgggcc gtggtttcca aattaaataa aactacgatg tcatcgagaa gtaaaatcaa 43260
ctgtgtccac attatcagtt ttgtgtatac gatgaaatag ggtaattcaa aatctagctt 43320
gatatgcctt ttggttcatt ttaaccttct gtaaacattt tttcagattt tgaacaagta 43380
aatccaaaaa aaaaaaaaaa aatctcaact caacactaaa ttattttaat gtataaaaga 43440
tgcttaaaac atttggctta aaagaaagaa gctaaaaaca tagagaactc ttgtaaattg 43500
aagtatgaaa atatactgaa ttgggtatta tatgaatttt tctgatttag gattcacatg 43560
atccaaaaag gaaatccaga agcactaatc agacattgga agtaggatta atcagtgatc 43620
agtaactatt aaattcaatt aaccgcggac atctacattt ttgaattgaa aaaaaattgg 43680
taattactct ttcttttttct ccatattgac catcatactc attgctgatc catgtagatt 43740
tcccggacat gaagccattt acaattgaat atatcctgcc gccgctgccg ctttgcaccc 43800
ggtggagctt gcatgttggt ttctacgcag aactgagccg gttaggcaga taatttccat 43860
tgagaactga gccatgtgca ccttcccccc aacacggtga gcgacggggc aacggagtga 43920
tccacatggg acttttaaac atcatccgtc ggatggcgtt gcgagagaag cagtcgatcc 43980
gtgagatcag tcgaccaatt ctcatgtttg acagcttatc atcgaatttc tgccattcat 44040
ccgcttatta tcacttattc aggcgtagca accaggcgtt taagggcacc aataactgcc 44100
ttaaaaaaat tacgccccgc cctgccactc atcgcagtac tgttgtaatt cattaagcat 44160
tctgccgaca tggaagccat cacaaacggc atgatgaacc tgaatcgcca gcggcatcag 44220
caccttgtcg ccttgcgtat aatatttgcc catggtgaaa acgggggcga agaagttgtc 44280
catattggcc acgtttaaat caaaactggt gaaactcacc cagggattgg ctgagacgaa 44340
aaacatattc tcaataaacc ctttagggaa ataggccagg ttttcaccgt aacacgccac 44400
atcttgcgaa tatatgtgta gaaactgccg gaaatcgtcg tggtattcac tccagagcga 44460
tgaaaacgtt tcagtttgct catggaaaac ggtgtaacaa gggtgaacac tatcccatat 44520
caccagctca ccgtctttca ttgccatacg gaattccgga tgagcattca tcaggcgggc 44580
aagaatgtga ataaaggccg gataaaactt gtgcttattt ttctttacgg tctttaaaaa 44640
ggccgtaata tccaggacct gcaggggggg gggggcgctg aggtctgcct cgtgaagaag 44700
gtgttgctga ctcataccag gcctgaatcg ccccatcatc cagccagaaa gtgagggagc 44760
cacggttgat gagagctttg ttgtaggtgg accagttggt gattttgaac ttttgctttg 44820
ccacggaacg gtctgcgttg tcgggaagat gcgtgatctg atccttcaac tcagcaaaag 44880
ttcgatttat tcaacaaagc cgccgtcccg tcaagtcagc gtaatgctct gccagtgtta 44940
caaccaatta accaattctg attagaaaaa ctcatcgagc atcaaatgaa actgcaattt 45000
attcatatca ggattatcaa taccatattt ttgaaaaagc cgtttctgta atgaaggaga 45060
aaactcaccg aggcagttcc ataggatggc aagatcctgg tatcggtctg cgattccgac 45120
tcgtccaaca tcaatacaac ctattaattt cccctcgtca aaaataaggt tatcaagtga 45180
gaaatcacca tgagtgacga ctgaatccgg tgagaatggc aaaagcttat gcatttcttt 45240
ccagacttgt tcaacaggcc agccattacg ctcgtcatca aaatcactcg catcaaccaa 45300
accgttattc attcgtgatt gcgcctgagc gagacgaaat acgcgatcgc tgttaaaagg 45360
acaattacaa acaggaatcg aatgcaaccg gcgcaggaac actgccagcg catcaacaat 45420
attttcacct gaatcaggat attcttctaa tacctggaat gctgttttcc cggggatcgc 45480
agtggtgagt aaccatgcat catcaggagt acggataaaa tgcttgatgg tcggaagagg 45540
cataaattcc gtcagccagt ttagtctgac catctcatct gtaacatcat tggcaacgct 45600
acctttgcca tgtttcagaa acaactctgg cgcatcgggc ttcccataca atcgatagat 45660
tgtcgcacct gattgcccga cattatcgcg agcccattta tacccatata aatcagcatc 45720
catgttggaa tttaatcgcg gcctcgagca agacgtttcc cgttgaatat ggctcataac 45780
acccccttgta ttactgttta tgtaagcaga cagttttatt gttcatgatg atatattttt 45840
atcttgtgca atgtaacatc agagattttg agacacaacg tggctttccc cccccccccct 45900
gcaggtcctg aacggtctgg ttataggtac attgagcaac tgactgaaat gcctcaaaat 45960
gttctttacg atgccattgg gatatatcaa cggtggtata tccagtgatt tttttctcca 46020
ttttagcttc cttagctcct gaaaatctcg ataactcaaa aaatacgccc ggtagtgatc 46080
ttatttcatt atggtgaaag ttggaacctc ttacgtgccg atcaacgtct cattttcgcc 46140
aaaagttggc ccagggcttc ccggtatcaa cagggacacc aggatttatt tattctgcga 46200
agtgatcttc cgtcacaggt atttattcgc gataagctca tggagcggcg taaccgtcgc 46260
acaggaagga cagagaaagc gcggatctgg gaagtgacgg acagaacggt caggacctgg 46320

attggggagg cggttgccgc cgctgctgct gacggtgtga cgttctctgt tccggtcaca 46380
ccacatacgt tccgccattc ctatgcgatg cacatgctgt atgccggtat accgctgaaa 46440
gttctgcaaa gcctgatggg acataagtcc atcagttcaa cggaagtcta cacgaaggtt 46500
tttgcgctgg atgtggctgc ccggcaccgg gtgcagtttg cgatgccgga gtctgatgcg 46560
gttgcgatgc tgaaacaatt atcctgagaa taaatgcctt ggcctttata tggaaatgtg 46620
gaactgagtg gatatgctgt ttttgtctgt taaacagaga agctggctgt tatccactga 46680
gaagcgaacg aaacagtcgg gaaaatctcc cattatcgta gagatccgca ttattaatct 46740
caggagcctg tgtagcgttt ataggaagta gtgttctgtc atgatgcctg caagcggtaa 46800
cgaaaacgat ttgaatatgc cttcaggaac aatagaaatc ttcgtgcggt gttacgttga 46860
agtggagcgg attatgtcag caatggacag aacaacctaa tgaacacaga accatgatgt 46920
ggtctgtcct tttacagcca gtagtgctcg ccgcagtcga gcgacagggc gaagccctcg 46980
agtgagcgag gaagcaccag ggaacagcac ttatatattc tgcttacaca cgatgcctga 47040
aaaaacttcc cttggggtta tccacttatc cacggggata tttttataat tatttttttt 47100
atagttttta gatcttcttt tttagagcgc cttgtaggcc tttatccatg ctggttctag 47160
agaaggtgtt gtgacaaatt gccctttcag tgtgacaaat caccctcaaa tgacagtcct 47220
gtctgtgaca aattgccctt aaccctgtga caaattgccc tcagaagaag ctgtttttc 47280
acaaagttat ccctgcttat tgactctttt ttatttagtg tgacaatcta aaaacttgtc 47340
acacttcaca tggatctgtc atggcggaaa cagcggttat caatcacaag aaacgtaaaa 47400
atagcccgcg aatcgtccag tcaaacgacc tcactgaggc ggcatatagt ctctcccggg 47460
atcaaaaacg tatgctgtat ctgttcgttg accagatcag aaaatctgat ggcaccctac 47520
aggaacatga cggtatctgc gagatccatg ttgctaaata tgctgaaata ttcggattga 47580
cctctgcgga agccagtaag gatatacggc aggcattgaa gagtttcgcg gggaaggaag 47640
tggtttttta tcgccctgaa gaggatgccg gcgatgaaaa aggctatgaa tcttttcctt 47700
ggtttatcaa acgtgcgcac agtccatcca gagggcttta cagtgtacat atcaacccat 47760
atctcattcc cttctttatc gggttacaga accggtttac gcagtttcgg cttagtgaaa 47820
caaaagaaat caccaatccg tatgccatgc gtttatacga atccctgtgt cagtatcgta 47880
agccggatgg ctcaggcatc gtctctctga aaatcgactg gatcatagag cgttaccagc 47940
tgcctcaaag ttaccagcgt atgcctgact tccgccgccg cttcctgcag gtctgtgtta 48000
atgagatcaa cagcagaact ccaatgcgcc tctcatacat tgagaaaaag aaaggccgcc 48060
agacgactca tatcgtattt tccttccgcg atatcacttc catgacgaca ggatagtctg 48120
agggttatct gtcacagatt tgagggtggt tcgtcacatt tgttctgacc tactgagggt 48180
aatttgtcac agttttgctg tttccttcag cctgcatgga ttttctcata ctttttgaac 48240
tgtaattttt aaggaagcca aatttgaggg cagtttgtca cagttgattt ccttctcttt 48300
cccttcgtca tgtgacctga tatcgggggt tagttcgtca tcattgatga gggttgatta 48360
tcacagttta ttactctgaa ttggctatcc gcgtgtgtac ctctacctgg agtttttccc 48420
acggtggata tttcttcttg cgctgagcgt aagagctatc tgacagaaca gttcttcttt 48480
gcttcctcgc cagttcgctc gctatgctcg gttacacggc tgcggcgagc gctagtgata 48540
ataagtgact gaggtatgtg ctcttcttat ctccttttgt agtgttgctc ttattttaaa 48600
caactttgcg gtttttttgat gactttgcga ttttgttgtt gctttgcagt aaattgcaag 48660
atttaataaa aaaacgcaaa gcaatgatta aaggatgttc agaatgaaac tcatggaaac 48720
acttaaccag tgcataaacg ctggtcatga aatgacgaag gctatcgcca ttgcacagtt 48780
taatgatgac agcccggaag cgaggaaaat aacccggcgc tggagaatag gtgaagcagc 48840
ggatttagtt ggggtttctt ctcaggctat cagagatgcc gagaaagcag ggcgactacc 48900
gcacccggat atggaaattc gaggacgggt tgagcaacgt gttggttata caattgaaca 48960
aattaatcat atgcgtgatg tgtttggtac gcgattgcga cgtgctgaag acgtatttcc 49020
accggtgatc ggggttgctg cccataaagg tggcgtttac aaaacctcag tttctgttca 49080
tcttgctcag gatctggctc tgaaggggct acgtgttttg ctcgtggaag gtaacgaccc 49140
ccagggaaca gcctcaatgt atcacggatg ggtaccagat cttcatattc atgcagaaga 49200
cactctcctg cctttctatc ttggggaaaa ggacgatgtc acttatgcaa taaagcccac 49260
ttgctggccg ggcttgaca ttattccttc ctgtctggct ctgcaccgta ttgaaactga 49320
gttaatgggc aaatttgatg aaggtaaact gcccaccgat ccacacctga tgctccgact 49380
ggccattgaa actgttgctc atgactatga tgtcatagtt attgacagcg cgcctaacct 49440
gggtatcggc acgattaatg tcgtatgtgc tgctgatgtg ctgattgttc ccacgcctgc 49500
tgagttgttt gactacacct ccgcactgca gtttttcgat atgcttcgtg atctgctcaa 49560
gaacgttgat cttaaagggt tcgagcctga tgtacgtatt ttgcttacca aatacagcaa 49620
tagtaatggc tctcagtccc cgtggatgga ggagcaaatt cgggatgcct ggggaagcat 49680
ggttctaaaa aatgttgtac gtgaaacgga tgaagttggt aaaggtcaga tccggatgag 49740
aactgttttt gaacaggcca ttgatcaacg ctcttcaact ggtgcctgga gaaatgctct 49800
ttctatttgg gaacctgtct gcaatgaaat tttcgatcgt ctgattaaac cacgctggga 49860
gattagataa tgaagcgtgc gcctgttatt ccaaaacata cgctcaatac tcaaccggtt 49920
gaagatactt cgttatcgac accagctgcc ccgatggtgg attcgttaat tgcgcgcgta 49980
ggagtaatgg ctcgcggtaa tgccattact ttgcctgtat gtggtcggga tgtgaagttt 50040
actcttgaag tgctccgggg tgatagtgtt gagaagacct ctcgggtatg gtcaggtaat 50100
gaacgtgacc aggagctgct tactgaggac gcactggatg atctcatccc ttcttttcta 50160
ctgactggtc aacagacacc ggcgttcggt cgaagagtat ctggtgtcat agaaattgcc 50220
gatgggagtc gccgtcgtaa agctgctgca cttaccgaaa gtgattatcg tgttctggtt 50280
ggcgagctgg atgatgagca gatggctgca ttatccagat tgggtaacga ttatcgccca 50340
acaagtgctt atgaacgtgg tcagcgttat gcaagccgat tgcagaatga atttgctgga 50400

aatatttctg cgctggctga tgcggaaaat atttcacgta agattattac ccgctgtatc 50460
aacaccgcca aattgcctaa atcagttgtt gctctttttt ctcaccccgg tgaactatct 50520
gcccggtcag gtgatgcact tcaaaaagcc tttacagata aagaggaatt acttaagcag 50580
caggcatcta accttcatga gcagaaaaaa gctggggtga tatttgaagc tgaagaagtt 50640
atcactcttt taacttctgt gcttaaaacg tcatctgcat caagaactag tttaagctca 50700
cgacatcagt ttgctcctgg agcgacagta ttgtataagg gcgataaaat ggtgcttaac 50760
ctggacaggt ctcgtgttcc aactgagtgt atagagaaaa ttgaggccat tcttaaggaa 50820
cttgaaaagc cagcaccctg atgcgaccac gttttagtct acgtttatct gtctttactt 50880
aatgtccttt gttacaggcc agaaagcata actggcctga atattctctc tgggcccact 50940
gttccacttg tatcgtcggt ctgataatca gactgggacc acggtcccac tcgtatcgtc 51000
ggtctgatta ttagtctggg accacggtcc cactcgtatc gtcggtctga ttattagtct 51060
gggaccacgg tcccactcgt atcgtcggtc tgataatcag actgggacca cggtcccact 51120
cgtatcgtcg gtctgattat tagtctggga ccatggtccc actcgtatcg tcggtctgat 51180
tattagtctg ggaccacggt cccactcgta tcgtcggtct gattattagt ctggaaccac 51240
ggtcccactc gtatcgtcgg tctgattatt agtctgggac cacggtccca ctcgtatcgt 51300
cggtctgatt attagtctgg gaccacgatc ccactcgtgt tgtcggtctg attatcggtc 51360
tgggaccacg gtcccacttg tattgtcgat cagactatca gcgtgagact acgattccat 51420
caatgcctgt caagggcaag tattgacatg tcgtcgtaac ctgtagaacg gagtaacctc 51480
ggtgtgcggt tgtatgcctg ctgtggattg ctgctgtgtc ctgcttatcc acaacatttt 51540
gcgcacggtt atgtggacaa aatacctggt tacccaggcc gtgccggcac gtttcctaca 51600
aggtagaatc cgcctgagtc gcaagggtga cttcgcctat attggacgac ggcgcgcaga 51660
gggcgacctc tttttgggtt acgattgtag gattatcact aaaacaatac atgaacatat 51720
tcaaatggca atctctctaa ggcattggaa ataaatacaa ataacagttg ggtggagttt 51780
ttcgacctga gggcgttaac tcttcaagga caacaagacc gtggacgtcg agcggctctc 51840
cgacaagcat gtcgcccgcc tggtcaagca gaccgcactc gccgccggcg cttcgatacc 51900
gttcgtattg gtccggcgaa actgtgagta tccgcatcgt aatctccgca tgaacaggtc 51960
atgcgaacag aaatcatctc acggtgcgtt tgcctacgtg cagatttgca cctcaggtga 52020
ttctaccgag tcggtgttcc aaggcgcgaa atgcgagcgg gtgaggccga ccagacgccg 52080
acaaggttgt gcagatctgc acttggtgcc acgtcgcaca gaagaaggga atcggtctaa 52140
ctcacagata gcatttgaag aatcgggatt tagtgtgatt tcgattgaaa cgcgcgtaac 52200
cgttcattaa ccaaaaacgt cttgcaacct cacccgcatt aggtaatcgt cacggataaa 52260
tggcaatacg cgccaattaa ccgtgacaag agataacacc gtgagcaaag ccgctgccat 52320
atcccgaaat gatcgcccgt cggtagatgt taccattggt gagcatgctg agcagctcag 52380
ctctcagctt caagcgatga gcgaggcttt gtttcctccg acgtcgcaca agagcttgcg 52440
caaattcacc tcgggtgaag ccgcacgctt gatgaaaata tctgactcaa ctcttcgaaa 52500
gatgacactg gctggcgaag ggccgcaacc tgaactcgcc agcaacggac ggcgctttta 52560
caccctcggt cagataaacg aaatccggca gatgcttgcc ggctcgactc gaggacgtga 52620
aagcattgat tttgtgcctc atcgccgagg ttctgagcat ttgcaagtcg ttgctgtaac 52680
caacttcaaa ggtggctctg ggaagacgac gacgtccgct catcttgcac agtatctggc 52740
gttgcaaggt tacagggttc tcgcagtcga tctcgatccg caggctagtc tttcagcact 52800
cctcggcgtt ctgccagaaa ctgatgtcgg tgcaaacgaa acgctctatg cggctattcg 52860
gtacgacgac acacgtcgtc cgttgcgaga tgtgatccga ccgacgtatt ttgatggtct 52920
tcaccttgtt cctggaaatc tcgagcttat ggagttcgag cataccaccc cgaaagcatt 52980
gactgacaaa ggtacgcgcg acggattgtt cttcactcgc gtggcccaag cctttgatga 53040
ggtcgccgac gattacgatg tcgtggtcat cgactgccct cctcagcttg ggtttttgac 53100
tctcagcggg ttgtgtgctg caacatcaat ggtaatcacc gtacatcctc agatgctgga 53160
tatcgcttcc atgagccagt ttctcctcat gacacgcgac cttctgggtg tcgtgaaaga 53220
ggcgggggc aatctccagt acgatttcat acgctatctc ttgacgcgct atgagcccca 53280
ggacgcgccg cagacgaaag tgacggcact gctgcgcaac atgttcgagg atcacgtcct 53340
tacaaatcct atggtcaagt cggcagcggt atctgatgcc ggtttaacca agcagacgct 53400
ctatgagata gggcgagaga accttacgcg atcgacatac gaccgggcga tggaatcttt 53460
agatgcggtg aattcggaga tcgaggcttt gatcaagatg gcgtgggggc gggtctaatg 53520
aaaggctttg cgttcctcac agatctgttg ggagctccca acagacaggt gttgattcgc 53580
cccctggaca tggggcactg gagaagccgg ggtaatttga gacgacgacg cacgcccatc 53640
gctaattggc cagggtgcag ttgtcttgtc ttgttgggag ctcccaacca agcgcatttg 53700
caatcaaaaa tgcgacgcca cgacgccaaa cccaagaggc cgatatcatg agccgcaaag 53760
acgcaatcga tactttgttc ctcaagaagc aacctgcgac cgatagagca gcagtcgaca 53820
agtcgaccgc tcgtgttcgt accggagcga tttcggccat gggttcgtct ttgcaagaga 53880
tggctgaggg cgcaaaggct gcagctcggc tgcaggatca actggctaca ggcgaagccg 53940
tcgtgtccct ggatccatcc atgatcgacg ggtcgccgat cgcggatcgg ctgccctcag 54000
acgtggatcc gaaattcgag cagcttgagg cgagcatttc gcaggagggg cagcaggtgc 54060
cggttcttgt cagaccgcac cctgaggctg ccggtcgata tcagatcgta tatggaaggc 54120
ggcggctgcg cgcggcagta aatctgcgga gagaggtttc tgccattgtt cgaaatctca 54180
cggactgtga actggtcgtg gcccagggcc gcgaaaatct taaccgcgct gacctctcgt 54240
tcattgagaa ggctctcttc gccctgcgcc tcgaagatgc gggttttgat agagccacca 54300
tcattgccgc gctatccact gacaaggccg acctcagccg ctacataact gtagcaaggg 54360
gcataccgct gaacctcgcc acacaaatcg gcccagcgtc gaaagcgggt cgatcgcgtt 54420
gggtcgtact tgccgagggg cttgggaagc ctaaggcaac ggacgcaatc gaagcgatgc 54480

ttgggtcaga gcagttcaag caatctgata gcgatacccg ctttaacctc attttcaacg 54540
ccgtttcaag gccacctgcg aagactccaa aaaaggtaag ggcctggagc acgccaaagg 54600
ggaaaaaggc agcgacgatc cgacaagaaa ctggacgaac ggcgctggtt ttcgacgaga 54660
gactggtgcc aacttttggc gaatatgtcg ctgaccagtt ggacagtctg tacgcccagt 54720
tcattgaaac caacggagga ggcaagctcg accaatagtc agggtttcat ccaatttaaa 54780
gctccgctcg actgagatgg actggctctc accgcaaaag aaaaaggccc ccgaaacggc 54840
gttccggaag accttctctg tagtctcgca gctaagagaa tcgcatttcc aggaatcgta 54900
gtcaagggtc ccgtaaggga aagcgtcatt tcgacgggcg gatttcaatt gcctaacaaa 54960
aggtaaaagg aaatgcagac gcatatctca acgacgtcct ttgggcggcg gccgatgaca 55020
ctcggccata ttgcaagcca gatggcagca aaagcggtcg catcagacac tgtcgcccac 55080
aaatggcagg tcttccagca catccgtgaa tcccggggac tgatcggagc cacggaccgc 55140
tcactctcga tcctgaacgc gctgttgacg ttttacccgg agaccgcctt gactggtggt 55200
gccgaactgg tcgtatggcc ttctaacgaa cagctgatgg ctcgcgccaa cggcatgccc 55260
gccacgacac tgcgccggca tcttgccata ctggttgatt gcgggctcat cattcgccgc 55320
gacagcccca atggcaagcg gttcgcccgc aagggaaggg gaggggagat tgagcaggcc 55380
tatgggttcg atctgtcgcc gatcgtcgcg cgggccgagg agttccgaga tctggcccag 55440
acagtgcaag ctgaaaaaaa ggccttccgg gtggccaagg agcgcttgac tcttcttcgt 55500
cgtgacattg tcaaaatgat cgaaactggc gtcgaagaga gcgttcctgg aaactgggga 55560
agagttaccc agacctatca ggggatcatc ggccgcctgc cacgctcggc acctcggcag 55620
cttgtcgaga gtattgggca agagcttcag gaactctgca tcgagatccg tgacgtattg 55680
gaatctttca caaaaacgat gaatctggac gccaatgagt cccatatcgg tcgccacaaa 55740
cagaattcaa atccagactc taaatttgaa tctgaataca gctctggaaa aaaagatgaa 55800
gcgggcggca gcgttgcgga aaccgacaat gtacggagct tgccgaaacg cgagctgcct 55860
ttgggaatcg tgctggatgc ctgccccgaa atgcgggaat tggcccaggg aggtccaatt 55920
cggcattggc gcgacttgct ggcggcggct gagcttgccc ggccgatgct ggggattagt 55980
ccgagcgcct ggcgggaggc ccgcgaaacc atgggcgatc aacacgcggc gatcacgctg 56040
gcttcgatct atcagcgggc cggtcagatc aataacgctg ggggctatct gcgcagcctg 56100
accgaccggg ccaaggatgg gaagttttcg acctggccga tggtcatggc gttgctccgg 56160
gcaaagctgg acgagcagaa gaatgcagtt ggcgctggaa agccgcgaac tgctgaggag 56220
gtcgaggatg acagccgcct ccacgtatcg gaatcgctgc tcaaaaacct gcgaaagccg 56280
agatcttggt gatcctctcg ctattcagcc gcggcgatgt cgacgtcggt gatcaacccg 56340
gaacgtcggg cgcggtcgat caggttcttg acggacgagg gcgcccattt ggatccaccg 56400
cgcggcgtgc gctcgtgcag tctttcaagc tggccggcga tctcgcggag cttcaggtct 56460
gggttcgaag aatggatgcc ggccacaagc gtcatcaggc gatcttcggg aagacgggga 56520
ggagattttt tcaggagcgc tgcatccacc aggcgttccg tcaccatcca cttcacggct 56580
cggcgaagac gttctggcgt ccagtcgagg ccccgctgct tgagcattcg ggcgatgtcg 56640
tcccatgtgt gatccggtcg catgcgacga acggtaggaa gccattggtt cgcggacgcc 56700
tgaatcctat cgccatatgc cgctttctgg gccgcggtca tccttgccag cgcctccggg 56760
cgcttttccc ggatgcccgg gttgccggaa agcttcccta ggcacaaacg ttgactcttg 56820
gatcgagctg gcagacaaag caataaccca cacagaggac gattaatggc tgacgaagag 56880
atccagaatc cgccggacgg tactgctgct gccgaagttg agccggctgc tcctagaggt 56940
agaagagcaa agaaagcacc agccgaaaca gcccgcacgg gatcgttcaa atccgtgaag 57000
ccgaaaaccc gcggcctcag caaccgagaa aaactggaga agatcggtca aatcgaagct 57060
caggtcgctg gcggcgcaac cttgaaggac gccgttaaga tcgtgggtat ttccgttcag 57120
acctattatc aatggaagag agctgcggtt caacctgtct cacagaatcc ggccgtgtct 57180
gtttcagttg acgatgaact cggcgagttc atccaactcg aggaggaaaa tcggcggctc 57240
agaaagcttc acgctgccgc aagcactcag ggcgcaaggg ctgctaaagg aagcggaaca 57300
cgtagaaagc cagtccgcag aaacggtgct gaccccggat gaatgtcagc tactgggcta 57360
tctggacaag ggaaaacgca agcgcaaaga gaaagcaggt agcttgcagt gggcttacat 57420
ggcgatagct agactgggcg gttttatgga cagcaagcga accggaattg ccagctgggg 57480
cgccctctgg gaaggttggg aagccctgca aagtaaactg gatggctttc ttgccgccaa 57540
ggatctgatg gcgcagggga tcaagatctg atcaagagac aggggccggc ccacgctgtc 57600
gtccaatctc ccaagacacg ccgccaccgc gcaccgtcgc ggcgagctgc tccccaagcc 57660
gctgttcgat gggcttccac cgcacgaggc tggacccctt ggcgtcatca agcatcccat 57720
ttcgcccgct ggcgagcatg acggggcgcc ggtagacgcc ggcaacgcgc tggccgtcgg 57780
ccacggggcg atgctccagg ccggtatcgg cggcaatgtc cttcgcggcc tgcgccagtt 57840
cccgagcccg ctgctgccca gcagattccg gtgaggatca cgcgctgccc gcgccgctcg 57900
gccagtccct gttcggccag gaagtccgcg cgctgctgta tcgcctactt ggcctcactg 57960
ctaaagccca ggtcgcccaa gcccgagcca ccgtcgatca actgctggtc aagccaggtg 58020
gcaccgatca cgcgggcctg ccgctcgatg ggcaggtgcg atttcagctc caccgtcacg 58080
ccaccaagac gctgggcgtc atagcggcgg ccctgctcgg gcagatcgtc cggcaccttc 58140
catagtccct cggccacgca caccacgatg ccggcctggt gcagggcttc gaggcggcgg 58200
gtgtggcccg caacgacttc cagcggatca cgcccgacac ggcctgacct agctcgacga 58260
ccaggtgaga tcggtgaccg cgctagtcaa gcaaccggcg tgccatggcg tttacggcca 58320
gatcaatcgc agcgccctcg ccctcgccgt cgccgtcgcc gatgaaccag gctgccgaca 58380
agcccgtcca tgcaatgatc cagcgaagaa gccgttcggg ctcaaacccg gtcgtcgcga 58440
ccacaatgct gagtcgagcc tccagcctgc ccggcaggat cgcaagcggg cgaccggggt 58500
cgctgagatc gggattcgtg aagatgttgg catagtcgaa ggtgcgctcg ccgagcagtc 58560

cgtgcgggtc gatggccagc cagccgcggt cgccgaagtc gagcacgttc tcgtggtgca 58620
ggtcgccgtg gagcgggcac acctcgcgcg gcgccgccag aagttggcgc gctacgctgg 58680
cggcgggcgc aagtgccgcg tgctcagcgg ccaaccggaa aagcggctgg aaccattcct 58740
gtagcggatg gagatcgggc ggcggtccgg accgcggcgc gtgcagacga gcggcggtgt 58800
cgcagaggat cgtggcatca ccgaaccgcg ccgtgcgcgg gtcgtcggtg agccagagtt 58860
tcagcaggcc gcccaggcgg cccaggtcgc cattgatgcg ggccagctcg cggacgtgct 58920
catagtccac gacgcccgtg attttgtagc cctggccgac ggccagcagg taggccgaca 58980
ggctcatgcc ggccgccgcc gccttttcct caatcgctct tcgttcgtct ggaaggcagt 59040
acaccttgat aggtgggctg cccttcctgg ttggcttggt ttcatcagcc atccgcttgc 59100
cctcatctgt tacgccggcg gtagccggcc agcctcgcag agcaggattc ccgttgagca 59160
ccgccaggtg cgaataaggg acagtgaaga aggaacaccc gctcgcgggt gggcctactt 59220
cacctatcct gcccggctga cgccgttgga tacaccaagg aaagtctaca cgaacccttt 59280
ggcaaaatcc tgtatatcgt gcgaaaaagg atggatatac cgaaaaaatc gctataatga 59340
ccccgaagca gggttatgca gcggaaaagc gctgcttccc tgctgttttg tggaatatct 59400
accgactgga aacaggcaaa tgcaggaaat tactgaactg aggggacagg cgagagacga 59460
tgccaaagag ctacaccgac gagctggccg agtgggttga atcccgcgcg gccaagaagc 59520
gccggcgtga tgaggctgcg gttgcgttcc tggcggtgag ggcggatgtc gaggcggcgt 59580
tagcgtccgg ctatgcgctc gtcaccattt gggagcacat gcgggaaacg gggaaggtca 59640
agttctccta cgagacgttc cgctcgcacg ccaggcggca catcaaggcc aagcccgccg 59700
atgtgcccgc accgcaggcc aaggctgcgg aacccgcgcc ggcacccaag acgccggagc 59760
cacggcggcc gaagcagggg ggcaaggctg aaaagccggc ccccgctgcg gccccgaccg 59820
gcttcacctt caacccaaca ccggacaaaa aggatcaacc gggctgcatc cgatgcaagt 59880
gtgtcgctgt cgactcgttg tacaacgaaa tccattccca ttccgcgctc aagatggctt 59940
cccctcggca gttcatcagg gctaaatcaa tctagccgac ttgtccggtg aaatgggctg 60000
cactccaaca gaaacaatca aacaaacata cacagcgact tattcacacg agctcaaatt 60060
acaacggtat atat 60074

<210> 280
<211> 44910
<212> DNA
<213> Artificial Sequence

<220>
<223> contig of insert and flanking sequences of LBFLFK T-DNA Locus 1

<400> 280
tatttttgtt catgtcttat tttctttttt cctaatgtaa ctatgagagg cttaaaaact 60
gtaaaatcag caaaacaata tacaattaca gtaaaaaatg tcacatacta agttctatat 120
atgactacaa gtctacaact caactaatca tccacataaa taattagttt tgtcataatt 180
atattatagt aagtacctga agaaaagata aagccatttc tggacaacat catctcgtat 240
tggcatcttt atacgtggac gacaaaatct atcacaataa tagttgctag atatagatac 300
atgaattttg taatatgatt aattaattgg cgcttcataa ctaaaataac taataaaggg 360
taaatgttct taaagtttca taattaatta tgtttcagag tggttgcatt atagtagttt 420
aaaattcaga agtgtacgcg acgagaaaag agatttgctg gtgactattg catcatcttt 480
gacatggaaa aaatcttaga taagaatagt ttgaaattag aaagctcgca attgaggtct 540
accaaaatta gaaattagaa agctcgcaat ccagtcagca tcatcacacc aaaagttagg 600
cccgaatagt ttgaaattag aaagctcgca attgaggtct acaggccaaa ttcgctctta 660
gccgtacaat attactcacc ggtgcgatgc cccccatcgt aggtgaaggt ggaaattaat 720
ggcgcgcctg atcactgatt agtaactatt acgtaagcct acgtagcgtc acgtgacgtt 780
agctaacgct acgtagcctc agctgacgtt acgtaagcct acgtagcgtc acgtgagctt 840
agctaacgct acctaggctc agctgacgtt acgtaacgct agctagcgtc actcctgcag 900
caaatttaca cattgccact aaacgtctaa acccttgtaa tttgtttttg ttttactatg 960
tgtgttatgt atttgatttg cgataaattt ttatatttgg tactaaattt ataacacctt 1020
ttatgctaac gtttgccaac acttagcaat ttgcaagttg attaattgat tctaaattat 1080
ttttgtcttc taaatacata tactaatcaa ctggaaatgt aaatatttgc taatatttct 1140
actataggag aattaaagtg agtgaatatg gtaccacaag gtttggagat ttaattgttg 1200
caatgctgca tggatggcat atacaccaaa cattcaataa ttcttgagga taataatggt 1260
accacacaag atttgaggtg catgaacgtc acgtggacaa aaggtttagt aatttttcaa 1320
gacaacaatg ttaccacaca caagttttga ggtgcatgca tggatgccct gtggaaagtt 1380
taaaaatatt ttggaaatga tttgcatgga agccatgtgt aaaaccatga catccacttg 1440
gaggatgcaa taatgaagaa aactacaaat ttacatgcaa ctagttatgc atgtagtcta 1500
tataatgagg attttgcaat actttcattc atacacactc actaagtttt acacgattat 1560
aatttcttca tagccagtac tgtttaagct tcactgtctc tgaatcggca aaggtaaacg 1620
tatcaattat tctacaaacc cttttatttt tcttttgaat taccgtcttc attggttata 1680
tgataacttg ataagtaaag cttcaataat tgaatttgat ctgtgttttt ttggccttaa 1740
tactaaatcc ttacataagc tttgttgctt ctcctcttgt gagttgagtg ttaagttgta 1800
ataatggttc actttcagct ttagaagaaa ccatggaagt tgttgagagg ttctacggag 1860
agttggatgg aaaggtttcc caaggagtga acgctttgtt gggatctttc ggagttgagt 1920

tgactgatac cccaactact aagggattgc cactcgttga ttctccaact ccaattgtgt 1980
tgggagtgtc tgtttacttg accatcgtga tcggaggatt gctttggatc aaggctagag 2040
atctcaagcc aagagcttct gagccattct tgttgcaagc tttggtgttg gtgcacaact 2100
tgttctgctt cgctttgtct ctttacatgt gcgtgggtat cgcttaccaa gctatcacct 2160
ggagatattc cttgtgggga aacgcttata acccaaagca caaggagatg gctatcctcg 2220
tttacctctt ctacatgtcc aagtacgtgg agttcatgga taccgtgatc atgatcctca 2280
agagatccac cagacagatt tctttcctcc acgtgtacca ccactcttct atctcccta 2340
tctggtgggc tattgctcac cacgctccag gaggagaggc ttattggagt gctgctctca 2400
actctggagt gcacgtgttg atgtacgctt actacttctt ggctgcttgc ttgagatctt 2460
ccccaaagct caagaacaag tacctcttct ggggaagata cctcacccaa ttccagatgt 2520
tccagttcat gctcaacttg gtgcaagctt actacgatat gaaaaccaac gctccatatc 2580
cacaatggct catcaagatc ctcttctact acatgatctc cctcttgttc ctcttcggaa 2640
acttctacgt gcaaaagtac atcaagccat ccgatggaaa gcaaaaggga gctaagaccg 2700
agtgatcgac aagctcgagt ttctccataa taatgtgtga gtagttccca gataagggaa 2760
ttagggttcc tatagggttt cgctcatgtg ttgagcatat aagaaaccct tagtatgtat 2820
ttgtatttgt aaaatacttc tatcaataaa atttctaatt cctaaaacca aaatccagta 2880
ctaaaatcca gatcccccga attaattcgg cgttaattca gctagctagc ctcagctgac 2940
gttacgtaac gctaggtagc gtcacgtgac gttagctaac gctaggtagc gtcagctgag 3000
cttacgtaag cgcttagcag atatttggtg tctaaatgtt tattttgtga tatgttcatg 3060
tttgaaatgg tggtttcgaa accagggaca acgttgggat ctgatagggt gtcaaagagt 3120
attatggatt gggacaattt cggtcatgag ttgcaaattc aagtatatcg ttcgattatg 3180
aaaattttcg aagaatatcc catttgagag agtctttacc tcattaatgt ttttagatta 3240
tgaaatttta tcatagttca tcgtagtctt tttggtgtaa aggctgtaaa aagaaattgt 3300
tcacttttgt tttcgtttat gtgaaggctg taaaagattg taaaagacta ttttggtgtt 3360
ttggataaaa tgatagtttt tatagattct tttgctttta gaagaaatac atttgaaatt 3420
ttttccatgt tgagtataaa ataccgaaat cgattgaaga tcatagaaat attttaactg 3480
aaaacaaatt tataactgat tcaattctct ccatttttat acctatttaa ccgtaatcga 3540
ttctaataga tgatcgattt tttatataat cctaattaac caacggcatg tattggataa 3600
ttaaccgatc aactctcacc cctaatagaa tcagtatttt ccttcgacgt taattgatcc 3660
tacactatgt aggtcatatc catcgtttta atttttggcc accattcaat tctgtcttgc 3720
ctttagggat gtgaatatga acggccaagg taagagaata aaaataatcc aaattaaagc 3780
aagagaggcc aagtaagata atccaaatgt acacttgtca ttgccaaaat tagtaaaata 3840
ctcggcatat tgtattccca cacattatta aaataccgta tatgtattgg ctgcatttgc 3900
atgaataata ctacgtgtaa gcccaaaaga acccacgtgt agcccatgca aagttaacac 3960
tcacgacccc attcctcagt ctccactata taaacccacc atccccaatc tcaccaaacc 4020
caccacacaa ctcacaactc actctcacac cttaaagaac caatcaccac caaaaaattt 4080
cacgatttgg aatttgattc ctgcgatcac aggtatgaca ggttagattt tgttttgtat 4140
agttgtatac atacttcttt gtgatgtttt gtttacttaa tcgaattttt ggagtgtttt 4200
aaggtctctc gtttagaaat cgtggaaaat atcactgtgt gtgtgttctt atgattcaca 4260
gtgtttatgg gtttcatgtt ctttgtttta tcattgaatg ggaagaaatt tcgttgggat 4320
acaaatttct catgttctta ctgatcgtta ttaggagttt ggggaaaaag gaagagtttt 4380
tttggttggt tcgagtgatt atgaggttat ttctgtattt gatttatgag ttaatggtcg 4440
ttttaatgtt gtagaccatg ggaaaaggat ctgagggaag atctgctgct agagagatga 4500
ctgctgaggc taacggagat aagagaaaga ccatcctcat tgagggagtg ttgtacgatg 4560
ctaccaactt caaacaccca ggaggttcca ttattaactt cctcaccgag ggagaagctg 4620
gagttgatgc tacccaagct tacagagagt tccatcagag atccggaaag gctgataagt 4680
acctcaagtc cctcccaaag ttggatgctt ctaaggtgga gtctaggttc tctgctaagg 4740
agcaggctag aagggacgct atgaccaggg attacgctgc tttcagagag gagttggttg 4800
ctgagggata cttcgatcca tctatcccac acatgatcta cagagtggtg gagattgtgg 4860
ctttgttcgc tttgtctttc tggttgatgt ctaaggcttc tccaacctct ttggttttgg 4920
gagtggtgat gaacggaatc gctcaaggaa gatgcggatg ggttatgcac gagatgggac 4980
acggatcttt cactggagtt atctggctcg atgataggat gtgcgagttc ttctacggag 5040
ttggatgtgg aatgtctgga cactactgga agaaccagca ctctaagcac cacgctgctc 5100
caaacagatt ggagcacgat gtggatttga acaccttgcc actcgttgct ttcaacgaga 5160
gagttgtgag gaaggttaag ccaggatctt tgttggcttt gtggctcaga gttcaggctt 5220
atttgttcgc tccagtgtct tgcttgttga tcggattggg atggaccttg tacttgcacc 5280
caagatatat gctcaggacc aagagacaca tggagtttgt gtggatcttc gctagatata 5340
tcggatggtt ctccttgatg ggagctttgg gatattctcc tggaacttct gtgggaatgt 5400
acctctgctc tttcggactt ggatgcatct acatcttcct ccaattcgct gtgtctcaca 5460
cccacttgcc agttaccaac ccagaggatc aattgcactg gcttgagtac gctgctgatc 5520
acaccgtgaa catctctacc aagtcttggt tggttacctg gtggatgtct aacctcaact 5580
tccaaatcga gcaccacttg ttcccaaccg ctccacaatt caggttcaag gagatctctc 5640
caagagttga ggctctcttc aagagacaca acctccctta ctacgatttg ccatacacct 5700
ctgctgtttc tactaccttc gctaacctct actctgttgg acactctgtt ggagctgata 5760
ccaagaagca ggattgactg ctttaatgag atatgcgaga cgcctatgat cgcatgatat 5820
ttgctttcaa ttctgttgtg cacgttgtaa aaaacctgag catgtgtagc tcagatcctt 5880
accgccggtt tcggttcatt ctaatgaata tatcacccgt tactatcgta tttttatgaa 5940
taatattctc cgttcaattt actgattgtc tacgtaggct cagctgagct tacctaaggc 6000

tacgtaggct cacgtgacgt tacgtaaggc tacgtagcgt cacgtgagct tacctaactc 6060
tagctagcct cacgtgacct tagctaacac taggtagcgt cagctcgacg gcccggactg 6120
tatccaactt ctgatctttg aatctctctg ttccaacatg ttctgaagga gttctaagac 6180
ttttcagaaa gcttgtaaca tgctttgtag actttctttg aattactctt gcaaactctg 6240
attgaaccta cgtgaaaact gctccagaag ttctaaccaa attccgtctt gggaaggccc 6300
aaaatttatt gagtacttca gtttcatgga cgtgtcttca aagatttata acttgaaatc 6360
ccatcatttt taagagaagt tctgttccgc aatgtcttag atctcattga aatctacaac 6420
tcttgtgtca gaagttcttc cagaatcaac ttgcatcatg gtgaaaatct ggccagaagt 6480
tctgaacttg tcatatttct taacagttag aaaaatttct aagtgtttag aattttgact 6540
tttccaaagc aaacttgact tttgactttc ttaataaaac aaacttcata ttctaacatg 6600
tcttgatgaa atgtgattct tgaaatttga tgttgatgca aaagtcaaag tttgactttt 6660
cagtgtgcaa ttgaccattt tgctcttgtg ccaattccaa acctaaattg atgtatcagt 6720
gctgcaaact tgatgtcatg gaagatctta tgagaaaatt cttgaagact gagaggaaaa 6780
attttgtagt acaacacaaa gaatcctgtt tttcatagtc ggactagaca cattaacata 6840
aaacaccact tcattcgaag agtgattgaa gaaggaaatg tgcagttacc tttctgcagt 6900
tcataagagc aacttacaga cacttttact aaaatactac aaagaggaag attttaacaa 6960
cttagagaag taatgggagt taaagagcaa cacattaagg gggagtgtta aaattaatgt 7020
gttgtaacca ccactacctt tagtaagtat tataagaaaa ttgtaatcat cacattataa 7080
ttattgtcct tatttaaaat tatgataaag ttgtatcatt aagattgaga aaaccaaata 7140
gtcctcgtct tgatttttga attattgttt tctatgttac ttttcttcaa gcctatataa 7200
aaactttgta atgctaaatt gtatgctgga aaaaaatgtg taatgaattg aatagaaatt 7260
atggtatttc aaagtccaaa atccatcaat agaaatttag tacaaaacgt aactcaaaaa 7320
tattctctta ttttaaattt tacaacaata taaaaatatt ctcttatttt aaattttaca 7380
ataatataat ttatcacctg tcacctttag aataccacca acaatattaa tacttagata 7440
ttttattctt aataattttg agatctctca atatatctga tatttatttt atatttgtgt 7500
catattttct tatgttttag agttaaccct tatatcttgg tcaaactagt aattcaatat 7560
atgagtttgt gaaggacaca ttgacatctt gaaacattgg ttttaacctt gttggaatgt 7620
taaaggtaat aaaacattca gaattatgac catctattaa tatacttcct ttgtctttta 7680
aaaaagtgtg catgaaaatg ctctatggta agctagagtg tcttgctggc ctgtgtatat 7740
caattccatt tccagatggt agaaactgcc actacgaata attagtcata agacacgtat 7800
gttaacacac gtccccttgc atgtttttttg ccatatattc cgtctctttc tttttcttca 7860
cgtataaaac aatgaactaa ttaatagagc gatcaagctg aacagttctt tgctttcgaa 7920
gttgccgcaa cctaaacagg tttttccttc ttctttcttc ttattaacta cgaccttgtc 7980
ctttgcctat gtaaaattac taggttttca tcagttacac tgattaagtt cgttatagtg 8040
gaagataaaa tgccctcaaa gcattttgca ggatatcttt gatttttcaa agatatggaa 8100
ctgtagagtt tgatagtgtt cttgaatgtg gttgcatgaa gtttttttgg tctgcatgtt 8160
attttttcct cgaaatatgt tttgagtcca acaagtgatt cacttgggat tcagaaagtt 8220
gttttctcaa tatgtaacag tttttttcta tggagaaaaa tcatagggac cgttggtttt 8280
ggcttcttta attttgagct cagattaaac ccattttacc cggtgttctt ggcagaattg 8340
aaaacagtac gtagtaccgc gcctaccatg tgtgttgaga ccgagaacaa cgatggaatc 8400
cctactgtgg agatcgcttt cgatggagag agagaaagag ctgaggctaa cgtgaagttg 8460
tctgctgaga agatggaacc tgctgctttg gctaagacct tcgctagaag atacgtggtt 8520
atcgagggag ttgagtacga tgtgaccgat ttcaaacatc ctggaggaac cgtgattttc 8580
tacgctctct ctaacactgg agctgatgct actgaggctt tcaaggagtt ccaccacaga 8640
tctagaaagg ctaggaaggc tttggctgct ttgccttcta gacctgctaa gaccgctaaa 8700
gtggatgatg ctgagatgct ccaggatttc gctaagtgga gaaaggagtt ggagagggac 8760
ggattcttca agccttctcc tgctcatgtt gcttacagat tcgctgagtt ggctgctatg 8820
tacgctttgg gaacctactt gatgtacgct agatacgttg tgtcctctgt gttggtttac 8880
gcttgcttct tcggagctag atgtggatgg gttcaacacg agggaggaca ctcttctttg 8940
accggaaaca tctggtggga taagagaatc caagctttca ctgctggatt cggattggct 9000
ggatctggag atatgtggaa ctccatgcac aacaagcacc acgctactcc tcaaaaagtg 9060
aggcacgata tggatttgga taccactcct gctgttgctt tcttcaacac cgctgtggag 9120
gataatagac ctaggggatt ctctaagtac tggctcagat tgcaagcttg gaccttcatt 9180
cctgtgactt ctggattggt gttgctcttc tggatgttct tcctccaccc ttctaaggct 9240
ttgaagggag gaaagtacga ggagcttgtg tggatgttgg ctgctcacgt gattagaacc 9300
tggaccatta aggctgttac tggattcacc gctatgcaat cctacggact cttcttggct 9360
acttcttggg tttccggatg ctacttgttc gctcacttct ctacttctca cacccacttg 9420
gatgttgttc ctgctgatga gcacttgtct tgggttaggt acgctgtgga tcacaccatt 9480
gatatcgatc cttctcaggg atgggttaac tggttgatgg gatacttgaa ctgccaagtg 9540
attcaccacc tcttcccttc tatgcctcaa ttcagacaac ctgaggtgtc cagaagattc 9600
gttgctttcg ctaagaagtg gaacctcaac tacaaggtga tgacttatgc tggagcttgg 9660
aaggctactt tgggaaacct cgataatgtg ggaaagcact actacgtgca cggacaacac 9720
tctggaaaga ccgcttgatt aatgaaggcc gcctcgaccg tacccccctgc agatagacta 9780
tactatgttt tagcctgcct gctggctagc tactatgtta tgttatgttg taaaataaac 9840
acctgctaag gtatatctat ctatatttta gcatggcttt ctcaataaat tgtctttcct 9900
tatcgtttac tatcttatac ctaataatga aataataata tcacatatga ggaacggggc 9960
aggtttaggc atatatatac gagtgtaggg cggagtgggg ctacgtagcg tcacgtgacg 10020
ttacctaagc ctaggtagcc tcagctgacg ttacgtaacg ctaggtaggc tcagctgaca 10080

```
cgggcaggac atagggacta ctacaagcat agtatgcttc agacaaagag ctaggaaaga  10140
actcttgatg gaggttaaga gaaaaaagtg ctagaggggc atagtaatca aacttgtcaa  10200
aaccgtcatc atgatgaggg atgacataat ataaaaagtt gactaaggtc ttggtagtac  10260
tctttgatta gtattatata ttggtgagaa catgagtcaa gaggagacaa gaaaccgagg  10320
aaccatagtt tagcaacaag atggaagttg caaagttgag ctagccgctc gattagttac  10380
atctcctaag cagtactaca aggaatggtc tctatacttt catgtttagc acatggtagt  10440
gcggattgac aagttagaaa cagtgcttag gagacaaaga gtcagtaaag gtattgaaag  10500
agtgaagttg atgctcgaca ggtcaggaga agtccctccg ccagatggtg actaccaagg  10560
ggttggtatc agctgagacc caaataagat tcttcggttg aaccagtggt tcgaccgaga  10620
ctcttagggt gggatttcac tgtaagattt gtgcattttg ttgaatataa attgacaatt  10680
ttttttattt aattatagat tatttagaat gaattacata tttagtttct aacaaggata  10740
gcaatggatg ggtatgggta caggttaaac atatctatta cccacccatc tagtcgtcgg  10800
gttttacacg tacccacccg tttacataaa ccagaccgga attttaaacc gtacccgtcc  10860
gttagcgggt ttcagattta cccgtttaat cgggtaaaac ctgattacta aatatatatt  10920
ttttatttga taaacaaaac aaaaatgtta atattttcat attggatgca attttaagaa  10980
acacatattc ataaatttcc atatttgtag gaaaataaaa agaaaaatat attcaagaac  11040
acaaatttca ccgacatgac ttttattaca gagttggaat tagatctaac aattgaaaaa  11100
ttaaaattaa gatagaatat gttgaggaac atgacatagt ataatgctgg gttacccgtc  11160
gggtaggtat cgaggcggat actactaaat ccatcccact cgctatccga taatcactgg  11220
tttcgggtat acccattccc gtcaacaggc ctttttaacc ggataatttc aacttatagt  11280
gaatgaattt tgaataaata gttagaatac caaaatcctg gattgcattt gcaatcaaat  11340
tttgtgaacc gttaaatttt gcatgtactt gggatagata taatagaacc gaattttcat  11400
tagtttaatt tataacttac tttgttcaaa gaaaaaaaat atctatccaa tttacttata  11460
ataaaaaata atctatccaa gttacttatt ataatcaact tgtaaaaagg taagaataca  11520
aatgtggtag cgtacgtgtg attatatgtg acgaaatgtt atatctaaca aaagtccaaa  11580
ttcccatggt aaaaaaaatc aaaatgcatg gcaggctgtt tgtaaccttg gaataagatg  11640
ttggccaatt ctggagccgc cacgtacgca agactcaggg ccacgttctc ttcatgcaag  11700
gatagtagaa caccactcca cccacctcct atattagacc tttgcccaac cctccccaac  11760
tttcccatcc catccacaaa gaaaccgaca tttttatcat aaatctggtg cttaaacact  11820
ctggtgagtt ctagtacttc tgctatgatc gatctcatta ccatttctta aatttctctc  11880
cctaaatatt ccgagttctt gatttttgat aacttcaggt tttctctttt tgataaatct  11940
ggtctttcca tttttttttt ttgtggttaa tttagtttcc tatgttcttc gattgtatta  12000
tgcatgatct gtgtttggat tctgttagat tatgtattgg tgaatatgta tgtgtttttg  12060
catgtctggt tttggtctta aaaatgttca aatctgatga tttgattgaa gctttttttag  12120
tgttggtttg attcttctca aaactactgt taatttacta tcatgttttc caactttgat  12180
tcatgatgac acttttgttc tgctttgtta taaaattttg gttggtttga ttttgtaatt  12240
atagtgtaat tttgttagga atgaacatgt tttaatactc tgttttcgat ttgtcacaca  12300
ttcgaattat taatcgataa tttaactgaa aattcatggt tctagatctt gttgtcatca  12360
gattatttgt ttcgataatt catcaaatat gtagtccttt tgctgatttg cgactgtttc  12420
atttttttctc aaaattgttt tttgttaagt ttatctaaca gttatcgttg tcaaaagtct  12480
ctttcatttt gcaaaatctt cttttttttt ttgtttgtaa ctttgttttt taagctacac  12540
atttagtctg taaaatagca tcgaggaaca gttgtcttag tagacttgca tgttcttgta  12600
acttctattt gtttcagttt gttgatgact gctttgattt tgtaggtcaa aggcgcaccc  12660
taccatggat gcttataacg ctgctatgga taagattgga gctgctatca tcgattggag  12720
tgatccagat ggaaagttca gagctgatag ggaggattgg tggttgtgcg atttcagatc  12780
cgctatcacc attgctctca tctacatcgc tttcgtgatc ttgggatctg ctgtgatgca  12840
atctctccca gctatggacc catacccctat caagttcctc tacaacgtgt ctcaaatctt  12900
cctctgcgct tacatgactg ttgaggctgg attcctcgct tataggaacg gatacaccgt  12960
tatgccatgc aaccacttca acgtgaacga tccaccagtt gctaacttgc tctggctctt  13020
ctacatctcc aaagtgtggg atttctggga taccatcttc attgtgctcg gaaagaagtg  13080
gagacaactc tctttcttgc acgtgtacca ccacaccacc atcttcctct tctactggtt  13140
gaacgctaac gtgctctacg atggagatat cttcttgacc atcctcctca acggattcat  13200
tcacaccgtg atgtacacct actacttcat ctgcatgcac accaaggatt ctaagaccgg  13260
aaagtctttg ccaatctggt ggaagtcatc tttgaccgct ttccaactct tgcaattcac  13320
catcatgatg tcccaagcta cctacttggt tttccacgga tgcgataagg tttccctcag  13380
aatcaccatc gtgtacttcg tgtacattct ctccctttttc ttcctcttcg ctcagttctt  13440
cgtgcaatcc tacatggctc caaagaagaa gaagtccgct tgatgttaat gaaggccgca  13500
gatatcagat ctggtcgacc tagaggatcc ccggccgcaa agataataac aaaagcctac  13560
tatataacgt acatgcaagt attgtatgat attaatgttt ttacgtacgt gtaaacaaaa  13620
ataattacgt ttgtaacgta tggtgatgat gtggtgcact aggtgtaggc cttgtattaa  13680
taaaaagaag tttgttctat atagagtggt ttagtacgac gatttattta ctagtcggat  13740
tggaatagag aaccgaattc ttcaatcctt gcttttgatc aagaattgaa accgaatcaa  13800
atgtaaaagt tgatatattt gaaaaacgta ttgagcttat gaaaatgcta atactctcat  13860
ctgtatggaa aagtgacttt aaaaccgaac ttaaaagtga caaaagggga atatcgcatc  13920
aaaccgaatg aaaccgatct acgtaggctc agctgagctt agctaagcct acctagcctc  13980
acgtgagatt atgtaaggct aggtagcgtc acgtgacgtt acctaacact agctagcgtc  14040
agctgagctt agctaaccct acgtagcctc acgtgagctt acctaacgct acgtagcctc  14100
acgtgactaa ggatgaccta cccattcttg agacaaatgt tacattttag tatcagagta  14160
```

aaatgtgtac ctataactca aattcgattg acatgtatcc attcaacata aaattaaacc 14220
agcctgcacc tgcatccaca tttcaagtat tttcaaaccg ttcggctcct atccaccggg 14280
tgtaacaaga cggattccga atttggaaga ttttgactca aattcccaat ttatattgac 14340
cgtgactaaa tcaactttaa cttctataat tctgattaag ctcccaattt atattcccaa 14400
cggcactacc tccaaaattt atagactctc atcccctttt aaaccaactt agtaaacgtt 14460
tttttttaa ttttatgaag ttaagttttt accttgtttt taaaaagaat cgttcataag 14520
atgccatgcc agaacattag ctacacgtta cacatagcat gcagccgcgg agaattgttt 14580
ttcttcgcca cttgtcactc ccttcaaaca cctaagagct tctctctcac agcacacaca 14640
tacaatcaca tgcgtgcatg cattattaca cgtgatcgcc atgcaaatct cctttatagc 14700
ctataaatta actcatcggc ttcactcttt actcaaacca aaactcatca atacaaacaa 14760
gattaaaaac atttcacgat ttggaatttg attcctgcga tcacaggtat gacaggttag 14820
attttgtttt gtatagttgt atacatactt ctttgtgatg ttttgtttac ttaatcgaat 14880
ttttggagtg ttttaaggtc tctcgtttag aaatcgtgga aaatatcact gtgtgtgtgt 14940
tcttatgatt cacagtgttt atgggtttca tgttctttgt tttatcattg aatgggaaga 15000
aatttcgttg ggatacaaat ttctcatgtt cttactgatc gttattagga gtttggggaa 15060
aaaggaagag ttttttggt tggttcgagt gattatgagg ttatttctgt atttgattta 15120
tgagttaatg gtcgttttaa tgttgtagac cgccatggct attttgaacc ctgaggctga 15180
ttctgctgct aacctcgcta ctgattctga ggctaagcaa agacaattgg ctgaggctgg 15240
atacactcac gttgagggtg ctcctgctcc tttgcctttg gagttgcctc acttctctct 15300
cagagatctc agagctgcta ttcctaagca ctgcttcgag agatctttcg tgacctccac 15360
ctactacatg atcaagaacg tgttgacttg cgctgctttg ttatacgctg ctaccttcat 15420
tgatagagct ggagctgctg cttatgtttt gtggcctgtg tactggttct tccagggatc 15480
ttacttgact ggagtgtggg ttatcgctca cgagtgtgga caccaggctt attgctcttc 15540
tgaggtggtg aacaacttga ttggactcgt gttgcactct gctttgttgg tgccttacca 15600
ctcttggaga atctctcaca gaaagcacca ctccaacact ggatcttgcg agaacgatga 15660
ggttttcgtt cctgtgacca gatctgtgtt ggcttcttct tggaacgaga ccttggagga 15720
ttctcctctc taccaactct accgtatcgt gtacatgttg gttgttggat ggatgcctgg 15780
atacctcttc ttcaacgcta ctggacctac taagtactgg ggaaagtcta ggtctcactt 15840
caacccttac tccgctatct atgctgatag ggagaggtgg atgatcgtgc tctccgatat 15900
tttcttggtg gctatgttgg ctgttttggc tgctttggtg cacactttct ccttcaacac 15960
gatggtgaag ttctacgtgg tgccttactt cattgtgaac gcttacttgg tgttgattac 16020
ctacctccaa cacaccgata cctacatccc tcacttcaga gagggagagt ggaattggtt 16080
gagaggagct ttgtgcactg tggatagatc atttggtcca ttcctcgatt ctgtggtgca 16140
tagaatcgtg gatacccacg tttgccacca tatcttctcc aagatgcctt tctatcactg 16200
cgaggaggct accaacgcta ttaagcctct cctcggaaag ttctacttga aggatactac 16260
tcctgttcct gttgctctct ggagatctta cacccactgc aagttcgttg aggatgatgg 16320
aaaggtggtg ttctacaaga acaagttata gttaatgaat aattgattgg ttcgagtatt 16380
atggcattgg gaaaactgtt tttcttgtac catttgttgt gcttgtaatt tactgtgttt 16440
tttattcggt tttcgctatc gaactgtgaa atggaaatgg atggagaaga gttaatgaat 16500
gatatggtcc ttttgttcat tctcaaatta atattatttg tttttctct tatttgttgt 16560
gtgttgaatt tgaaattata agagatatgc aaacattttg ttttgagtaa aaatgtgtca 16620
aatcgtggcc tctaatgacc gaagttaata tgaggagtaa aacacttgta gttgtaccat 16680
tatgcttatt cactaggcaa caaatatatt ttcagaccta gaaaagctgc aaatgttact 16740
gaatacaagt atgtcctctt gtgttttaga catttatgaa ctttccttta tgtaattttc 16800
cagaatcctt gtcagattct aatcattgct ttataattat agttatactc atggatttgt 16860
agttgagtat gaaaatattt tttaatgcat tttatgactt gccaattgat tgacaacatg 16920
catcaatcta gctagcctca gctgacgtta cgtaacgcta ggtagcgtca cgtgacgtta 16980
gctaacgcta ggtagcgtca gctgagctta cgtaagcgca cagatgaata ctagctgttg 17040
ttcacagttc tagtgtctcc tcattacgtg aattcaagct acgatcacta tctcaactcc 17100
tacataaaca tcagaatgct acaaaactat gcacaaaaac aaaagctaca tctaatacgt 17160
gaatcaatta ctctcatcac aagaaagaag atttcaatca ccgtcgagaa ggaggattca 17220
gttaattgaa tcaaagttcc gatcaaactc gaagactggt gagcacgagg acgacgaaga 17280
agagtgtctc gaagatacaa caagcaagaa atctactgag tgacctcctg aagttattgg 17340
cgcgattgag agaatcaatc cgaattaatt tcggggaaaa agataaatta gatactaagc 17400
gatgggcttg ggctgggcta agaaacaggt ggcaattggg ctggaggacc ccgcgattca 17460
tagcttccga tagcccaaaa aaaaacggat aacatattta tcgggtattt gaatttcagt 17520
gaaataagat attttctttt tgttaggaaa attttagaaa ataatggaaa ttaaatagcg 17580
attatgttac aagatacgat cagcatcggg cagtgcaaaa tgctatagct tcccaagatt 17640
tgatcctttt gggttatctc ctaatgacaa ttagtttagg attttgaaac ttatattaat 17700
actattatcc gacaacactt gtttcagctt cttattttaa catttttgt ttttttctat 17760
tcttcttccc atcagcattt tctttttaaa aaattgaata ctttaacttt ttaaaaattt 17820
cacaatgatc agatgatatt atggaagatc tcaagagtta aatgtatcca tcttggggca 17880
ttaaaaccgg tgtacgggat gataaataca gactttatat catatgatag ctcagtaatt 17940
catatttatc acgttgctaa aaaaattata aggtactagt agtcaacaaa atcaattaaa 18000
gagaaagaaa gaaacgcatg tgaagagagt ttacaactgg aaaagtaaaa taaaaattaa 18060
cgcatgttga atgctgacat gtcagtatgt ccatgaatcc acgtatcaag cgccattcat 18120
cgatcgtctt cctctttcta aatgaaaaca acttcacaca tcacaacaaa caatacacac 18180
aagacccct ctctctcgtt gtctctctgc cagcgaccaa atcgaagctt gagaagaaca 18240

agaaggggtc aaaccatggc ttctacatct gctgctcaag acgctgctcc ttacgagttc 18300
ccttctctca ctgagatcaa gagggctctt ccttctgagt gtttcgaggc ttctgttcct 18360
ctttctctct actacaccgc tagatctctt gctcttgctg gatctctcgc tgttgctctc 18420
tcttacgcta gagctttgcc tcttgttcag gctaacgctc ttcttgatgc tactctctgc 18480
actggatacg ttcttctcca gggaatcgtt ttctggggat tcttcaccgt tggtcacgat 18540
tgtggacacg gagctttctc tagatctcac gtgctcaact tctctgttgg aaccctcatg 18600
cactctatca tccttacccc tttcgagtct tggaagctct ctcacagaca ccaccacaag 18660
aacaccggaa acatcgataa ggacgagatc ttctaccctc aaagagaggc tgattctcac 18720
cctgtttcta gacaccttgt gatgtctctt ggatctgctt ggttcgctta ccttttcgct 18780
ggattccctc ctagaaccat gaaccacttc aacccttggg aggctatgta tgttagaaga 18840
gtggctgctg tgatcatctc tctcggagtt cttttcgctt tcgctggact ctactcttac 18900
ctcaccttcg ttcttggatt caccactatg gctatctact acttcggacc tctcttcatc 18960
ttcgctacca tgcttgttgt taccactttc ctccaccaca acgatgagga gacaccttgg 19020
tacgctgatt ctgagtggac ttacgtgaag ggaaacctct cttctgtgga cagatcttac 19080
ggtgctctca tcgacaacct tagccacaac atcggaactc accagatcca ccacctcttc 19140
cctatcatcc ctcactacaa gctcaacgat gctactgctg ctttcgctaa ggctttccct 19200
gagcttgtta ggaaaaacgc tgctcctatc atcccaactt tcttcaggat ggctgctatg 19260
tacgctaagt acggagttgt tgacactgat gctaagacct tcactctcaa ggaggctaag 19320
gctgctgcta agactaagtc atcttgatga ttaatgaata attgattgta catactatat 19380
tttttgttta ccttgtgtta gtttaatgtt cagtgtcctc tctttattgt ggcacgtctc 19440
tttgttgtat gttgtgtcta tacaaagttg aaataatgga aagaaaagga agagtgtaat 19500
ttgttttgtt ttaagtgttt ataaatatat atatataggt catttagata gttctaggtt 19560
tctataaaac tctctctctg gaagtagaat ctgtttttga gaggatccag ttgcctacta 19620
atctccccca aaacccttca agcttaacct tcctcttcac aacaacagag gaaacacatc 19680
tcttgagctc tgagttctct tctttgagca tgtctatcgc taaactcatc tgccttatag 19740
cttccctctt ctcttcatct ctctctctca ccatttcgct gtaaaactta ttctcctccc 19800
tcagcctctc tatctcttcc ttcagcatct cacaattccc accataatcg actgaggatg 19860
attcaccgtc atcaacttca gactcagcgt tgtagtcgtc atgagtctca caagccttgg 19920
accaagaaga ctcatcatcg caagttgatg atttatcatg atgcttctct gagccgtgtt 19980
tgctacgtag cgtcacgtga cgttacctaa gcctaggtag cctcagctga cgttacgtaa 20040
cgctaggtag gctcagctga ctgcagcaaa tttacacatt gccactaaac gtctaaaccc 20100
ttgtaatttg tttttgtttt actatgtgtg ttatgtattt gatttgcgat aaatttttat 20160
atttggtact aaatttataa caccttttat gctaacgttt gccaacactt agcaatttgc 20220
aagttgatta attgattcta aattattttt gtcttctaaa tacatatact aatcaactgg 20280
aaatgtaaat atttgctaat atttctacta taggagaatt aaagtgagtg aatatggtac 20340
cacaaggttt ggagatttaa ttgttgcaat gctgcatgga tggcatatac accaaacatt 20400
caataattct tgaggataat aatggtacca cacaagattt gaggtgcatg aacgtcacgt 20460
ggacaaaagg tttagtaatt tttcaagaca acaatgttac cacacacaag ttttgaggtg 20520
catgcatgga tgccctgtgg aaagtttaaa aatattttgg aaatgatttg catggaagcc 20580
atgtgtaaaa ccatgacatc cacttggagg atgcaataat gaagaaaact acaaatttac 20640
atgcaactag ttatgcatgt agtctatata atgaggattt tgcaatactt tcattcatac 20700
acactcacta agttttacac gattataatt tcttcatagc cagtactgtt taagcttcac 20760
tgtctctgaa tcggcaaagg taaacgtatc aattattcta caaacccttt tatttttctt 20820
ttgaattacc gtcttcattg gttatatgat aacttgataa gtaaagcttc aataattgaa 20880
tttgatctgt gtttttttgg ccttaatact aaatccttac ataagctttg ttgcttctcc 20940
tcttgtgagt tgagtgttaa gttgtaataa tggttcactt tcagctttag aagaaacgcg 21000
ccttccatgg ctacaaagga ggcttacgtt ttcccaactc tcaccgagat caagagatct 21060
ctcccaaagg attgcttcga ggcttctgtg cctttgtctc tctactacac tgtgagatgc 21120
ttggttattg ctgtggcttt gaccttcgga ttgaactacg ctagagcttt gccagaggtt 21180
gagtctttct gggctttgga tgctgctttg tgcactggat atatcctcct ccagggaatt 21240
gtgttctggg gattcttcac tgttggacac gatgctggac acggagcttt ctctagatac 21300
cacctcttga acttcgttgt gggaaccttc atgcactctc tcatcttgac cccattcgag 21360
tcttggaagt tgacccacag acaccaccac aagaacaccg gaaacatcga tagagatgag 21420
gtgttctacc cacagagaaa ggctgatgat cacccattgt ccaggaactt gatcttggct 21480
ttgggagctg cttggcttgc ttatttggtg gagggattcc caccaagaaa ggtgaaccac 21540
ttcaacccat tcgagccact tttgtgaga caagtgtccg ctgtggttat ctctttgctc 21600
gctcacttct tcgttgctgg actctctatc tacttgtctc tccagttggg acttaagacc 21660
atggctatct actactacgg accagttttc gtgttcggat ctatgttggt gattaccacc 21720
ttcttgcacc acaacgatga ggagactcca tggtatgctg attctgagtg gacttacgtg 21780
aagggaaact tgtcctctgt ggatagatct tacggtgctc tcatcgataa cctctcccac 21840
aacatcggaa ctcaccagat ccaccacctc ttcccaatta tcccacacta caagctcaag 21900
aaggctactg ctgctttcca ccaagctttc ccagagcttg tgagaaagtc cgatgagcca 21960
atcatcaagg ctttcttcag agtgggaagg ttgtatgcta actacggagt ggttgatcaa 22020
gaggctaagc tcttcacttt gaaggaggct aaggctgcta ctgaagctgc tgctaagacc 22080
aagtctacct gattaatgaa tcgacaagct cgagtttctc cataataatg tgtgagtagt 22140
tcccagataa gggaattagg gttcctatag ggtttcgctc atgtgttgag catataagaa 22200
acccttagta tgtatttgta tttgtaaaat acttctatca ataaaatttc taattcctaa 22260
aaccaaaatc cagtactaaa atccagatcc cccgaattaa ttcggcgtta attcagctac 22320

gtaggctcag ctgagcttac ctaaggctac gtaggctcac gtgacgttac gtaaggctac 22380
gtagcgtcac gtgagcttac ctaactctag ctagcctcac gtgaccttag ctaacactag 22440
gtagcgtcag cacagatgaa tactagctgt tgttcacagt tctagtgtct cctcattacg 22500
tgaattcaag ctacgatcac tatctcaact cctacataaa catcagaatg ctacaaaact 22560
atgcacaaaa acaaaagcta catctaatac gtgaatcaat tactctcatc acaagaaaga 22620
agatttcaat caccgtcgag aaggaggatt cagttaattg aatcaaagtt ccgatcaaac 22680
tcgaagactg gtgagcacga ggacgacgaa gaagagtgtc tcgaagatac aacaagcaag 22740
aaatctactg agtgacctcc tgaagttatt ggcgcgattg agagaatcaa tccgaattaa 22800
tttcggggaa aaagataaat tagatactaa gcgatgggct tgggctgggc taagaaacag 22860
gtggcaattg ggctggagga ccccgcgatt catagcttcc gatagcccaa aaaaaaacgg 22920
ataacatatt tatcgggtat ttgaatttca gtgaaataag atattttctt tttgttagga 22980
aaattttaga aaataatgga aattaaatag cgattatgtt acaagatacg atcagcatcg 23040
ggcagtgcaa aatgctatag cttcccaaga tttgatcctt ttgggttatc tcctaatgac 23100
aattagttta ggattttgaa acttatatta atactattat ccgacaacac ttgtttcagc 23160
ttcttatttt aacatttttt gttttttct attcttcttc ccatcagcat tttcttttta 23220
aaaaattgaa tactttaact ttttaaaaat ttcacaatga tcagatgata ttatggaaga 23280
tctcaagagt taaatgtatc catcttgggg cattaaaacc ggtgtacggg atgataaata 23340
cagactttat atcatatgat agctcagtaa ttcatattta tcacgttgct aaaaaaatta 23400
taaggtacta gtagtcaaca aaatcaatta aagagaaaga aagaaacgca tgtgaagaga 23460
gtttacaact ggaaaagtaa aataaaaatt aacgcatgtt gaatgctgac atgtcagtat 23520
gtccatgaat ccacgtatca agcgccattc atcgatcgtc ttcctctttc taaatgaaaa 23580
caacttcaca catcacaaca aacaatacac acaagacccc ctctctctcg ttgtctctct 23640
gccagcgacc aaatcgaagc ttgagaagaa caagaagggg tcaaaccatg ggaaaaggat 23700
ctgagggaag atctgctgct agagagatga ctgctgaggc taacggagat aagagaaaga 23760
ccatcctcat tgagggagtg ttgtacgatg ctaccaactt caaacaccca ggaggttcca 23820
ttattaactt cctcaccgag ggagaagctg gagttgatgc tacccaagct tacagagagt 23880
tccatcagag atccggaaag gctgataagt acctcaagtc cctcccaaag ttggatgctt 23940
ctaaggtgga gtctaggttc tctgctaagg agcaggctag aagggacgct atgaccaggg 24000
attacgctgc tttcagagag gagttggttg ctgagggata cttcgatcca tctatcccac 24060
acatgatcta cagagtggtg gagattgtgg ctttgttcgc tttgtctttc tggttgatgt 24120
ctaaggcttc tccaacctct ttggttttgg gagtggtgat gaacggaatc gctcaaggaa 24180
gatgcggatg ggttatgcac gagatgggac acggatcttt cactggagtt atctggctcg 24240
atgataggat gtgcgagttc ttctacggag ttggatgtgg aatgtctgga cactactgga 24300
agaaccagca ctctaagcac cacgctgctc caaacagatt ggagcacgat gtggatttga 24360
acaccttgcc actcgttgct ttcaacgaga gagttgtgag gaaggttaag ccaggatctt 24420
tgttggcttt gtggctcaga gttcaggctt atttgttcgc tccagtgtct tgcttgttga 24480
tcggattggg atggaccttg tacttgcacc caagatatat gctcaggacc aagagacaca 24540
tggagtttgt gtggatcttc gctagatata tcggatggtt ctccttgatg ggagctttgg 24600
gatattctcc tggaacttct gtgggaatgt acctctgctc tttcggactt ggatgcatct 24660
acatcttcct ccaattcgct gtgtctcaca cccacttgcc agttaccaac ccagaggatc 24720
aattgcactg gcttgagtac gctgctgatc acaccgtgaa catctctacc aagtcttggt 24780
tggttacctg gtggatgtct aacctcaact tccaaatcga gcaccacttg ttcccaaccg 24840
ctccacaatt caggttcaag gagatctctc caagagttga ggctctcttc aagagacaca 24900
acctccccta ctacgatttg ccatacacct ctgctgtttc tactaccttc gctaacctct 24960
actctgttgg acactctgtt ggagctgata ccaagaagca ggattgatga ttaatgaata 25020
attgattgta catactatat tttttgttta ccttgtgtta gtttaatgtt cagtgtcctc 25080
tctttattgt ggcacgtctc tttgttgtat gttgtgtcta tacaaagttg aaataatgga 25140
aagaaaagga agagtgtaat ttgttttgtt ttaagtgttt ataaatatat atatataggt 25200
catttagata gttctaggtt tctataaaac tctctctctg gaagtagaat ctgtttttga 25260
gaggatccag ttgcctacta atctccccca aaacccttca agcttaacct tcctcttcac 25320
aacaacagag gaaacacatc tcttgagctc tgagttctct tctttgagca tgtctatcgc 25380
taaactcatc tgccttatag cttccctctt ctcttcatct ctctctctca ccatttcgct 25440
gtaaaactta ttctcctccc tcagcctctc tatctcttcc ttcagcatct cacaattccc 25500
accataatcg actgaggatg attcaccgtc atcaacttca gactcagcgt tgtagtcgtc 25560
atgagtctca caagccttgg accaagaaga ctcatcatcg caagttgatg atttatcatg 25620
atgcttctct gagccgtgtt tgctacctag agtcagctga gcttagctaa cgctagctag 25680
tgtcagctga cgttacgtaa ggctaactag cgtcacgtga ccttacgtaa cgctacgtag 25740
gctcagctga gcttagctaa ccctagctag tgtcacgtga gcttacgcta ctatagaaaa 25800
tgtgttatat cgacatgacc agacaaaggg gcaacagtta acaaaacaat taattctttc 25860
atttgagatt aaggaaggta aggtactaaa aagattaaaa aaaatgagct tatctctttg 25920
tttctgtaat aataatataa gtgtgataaa cttttaatat aataattgta attaggtttt 25980
ctacagatga gcaccactca gagacaagat aagaagaaaa caattttgtt aaacatgatt 26040
atagaaactt ttagttaagt cttgaagtat caatataaca aaaaaaagta cacacgacta 26100
tgacaataaa cccactaccg tcaggttatc atttcgatga aatgttttga tatcattaaa 26160
tataacagtc acaaaaaatc atctaattat aacaatataa cttatacata tatttaacta 26220
aaaacttaga gtttttgtaa tgattctaat tgatgattag agtttataga aatacaatta 26280
aataaaaaat ataattttaa aaaaacatag taaagtcaat gagatcctct ctgacctcag 26340
tgatcattta gtcatgtatg tacaacaatc attgttcatc acatgactgt aaaataaata 26400

aggataaact tgggaatata tataatatat tgtattaaat aaaaaaggga aatacaaata 26460
tcaattttag attcccgagt tgacacaact caccatgcac gctgccacct cagctcccag 26520
ctctcgtcac atgtctcatg tcagttaggt ctttggtttt tagtctttga cacaactcgc 26580
catgcatgtt gccacgtgag ctcgttcctc ttcccatgat ctcaccactg ggcatgcatg 26640
ctgccacctc agctggcacc tcttctctat atgtccctag aggccatgca cagtgccacc 26700
tcagcactcc tctcagaacc catacgtacc tgccaatcgg cttctctcca taaatatcta 26760
tttaaattat aactaattat ttcatatact taattgatga cgtggatgca ttgccatcgt 26820
tgtttaataa ttgttaatta cgacatgata aataaaatga aagtaaaaag tacgaaagat 26880
tttccatttg ttgttgtata aatagagaag tgagtgatgc ataatgcatg aatgcatgac 26940
cgcgccacca tgactgttgg atacgacgag gagatcccat tcgagcaagt tagggctcat 27000
aacaagccag acgacgcttg gtgtgctatt cacggacacg tgtacgacgt taccaagttc 27060
gcttcagttc acccaggagg agatattatc ttgctcgctg ctggaaagga agctactgtc 27120
ctctacgaga cctaccatgt tagaggagtg tctgacgctg tgctcagaaa gtacagaata 27180
ggaaagttgc cagacggaca aggaggagct aacgagaagg agaagagaac cttgtctgga 27240
ttgtcctctg cttcttacta cacctggaac tccgatttct acagagtgat gagggagaga 27300
gttgtggcta gattgaagga gagaggaaag gctagaagag gaggatacga actctggatc 27360
aaggctttct tgctccttgt tggattctgg tcctctcttt actggatgtg caccctcgat 27420
ccatctttcg gagctatctt ggctgctatg tctttgggag tgttcgctgc ttttgttgga 27480
acctgcatcc aacacgatgg aaaccacgga gctttcgctc aatctagatg ggttaacaag 27540
gtggcaggat ggactttgga tatgatcgga gcttctggaa tgacttggga gttccaacac 27600
gtgttgggac accacccata cactaacttg atcgaggagg agaacggatt gcaaaaggtg 27660
tccggaaaga agatggatac caagttggct gatcaagagt ctgatccaga tgtgttctcc 27720
acctacccaa tgatgagatt gcacccttgg caccagaaga ggtggtatca caggttccag 27780
cacatctacg gacctttcat cttcggattc atgaccatca acaaggtggt gactcaagat 27840
gttggagtgg tgttgagaaa gagactcttc caaatcgatg ctgagtgcag atatgcttcc 27900
ccaatgtacg ttgctaggtt ctggattatg aaggctttga ccgtgttgta tatggttgct 27960
ttgcccttgtt atatgcaagg accttggcac ggattgaaac tcttcgctat cgctcacttc 28020
acttgcggag aggttttggc taccatgttc atcgtgaacc acattatcga gggagtgtct 28080
tacgcttcta aggatgctgt taagggaact atggctccac caaagactat gcacggagtg 28140
accccaatga acaacactag aaaggaggtt gaggctgagg cttctaagtc tggagctgtg 28200
gttaagtctg tgccattgga tgattgggct gctgttcagt gccaaacctc tgtgaactgg 28260
tctgttggat cttggttttg gaaccacttc tctggaggac tcaaccacca aatcgagcac 28320
cacctcttcc caggattgtc tcacgagacc tactaccaca tccaagacgt ggttcaatct 28380
acctgtgctg agtacggagt tccataccaa cacgagccat ctttgtggac tgcttactgg 28440
aagatgctcg aacaccttag acaattggga aacgaggaga ctcacgagtc atggcagaga 28500
gctgcttgat taatgaacta agactcccaa aaccaccttc cctgtgacag ttaaaccctg 28560
cttatacctt tcctcctaat aatgttcatc tgtcacacaa actaaaataa ataaaatggg 28620
agcaataaat aaaatgggag ctcatatatt tacaccattt acactgtcta ttattcacca 28680
tgccaattat tacttcataa ttttaaaatt atgtcatttt taaaaattgc ttaatgatgg 28740
aaaggattat tataagttaa aagtataaca tagataaact aaccacaaaa caaatcaata 28800
taaactaact tactctccca tctaattttt atttaaattt ctttacactt ctcttccatt 28860
tctatttcta caacattatt taacattttt attgtatttt tcttactttc taactctatt 28920
catttcaaaa atcaatatat gtttatcacc acctctctaa aaaaaacttt acaatcattg 28980
gtccagaaaa gttaaatcac gagatggtca ttttagcatt aaaacaacga ttcttgtatc 29040
actatttttc agcatgtagt ccattctctt caaacaaaga cagcggctat ataatcgttg 29100
tgttatattc agtctaaaac aactagctag cctcagctga cgttacgtaa cgctaggtag 29160
cgtcacgtga cgttagctaa cgctaggtag cgtcagctga gcttacgtaa gcgccacggg 29220
caggacatag ggactactac aagcatagta tgcttcagac aaagagctag gaaagaactc 29280
ttgatggagg ttaagagaaa aaagtgctag aggggcatag taatcaaact tgtcaaaacc 29340
gtcatcatga tgagggatga cataatataa aaagttgact aaggtcttgg tagtactctt 29400
tgattagtat tatatattgg tgagaacatg agtcaagagg agacaagaaa ccgaggaacc 29460
atagtttagc aacaagatgg aagttgcaaa gttgagctag ccgctcgatt agttacatct 29520
cctaagcagt actacaagga atggtctcta tactttcatg tttagcacat ggtagtgcgg 29580
attgacaagt tagaaacagt gcttaggaga caaagagtca gtaaaggtat tgaaagagtg 29640
aagttgatgc tcgacaggtc aggagaagtc cctccgccag atggtgacta ccaaggggtt 29700
ggtatcagct gagacccaaa taagattctt cggttgaacc agtggttcga ccgagactct 29760
tagggtggga tttcactgta agatttgtgc attttgttga atataaattg acaatttttt 29820
ttatttaatt atagattatt tagaatgaat tacatattta gtttctaaca aggatagcaa 29880
tggatgggta tgggtacagg ttaaacatat ctattaccca cccatctagt cgtcgggttt 29940
tacacgtacc cacccgttta cataaaccag aacggaattt taaaccgtac ccgtccgtta 30000
gcgggtttca gatttacccg tttaatcggg taaaacctga ttactaaata tatatttttt 30060
atttgataaa caaaacaaaa atgttaatat tttcatattg gatgcaattt taagaaacac 30120
atattcataa atttccatat ttgtaggaaa ataaaaagaa aaatatattc aagaacacaa 30180
atttcaccga catgactttt attacagagt tggaattaga tctaacaatt gaaaaattaa 30240
aattaagata gaatatgttg aggaacatga catagtataa tgctgggtta cccgtcgggt 30300
aggtatcgag gcggatacta ctaaatccat cccactcgct atccgataat cactggtttc 30360
gggtataccc attcccgtca acaggccttt ttaaccggat aatttcaact tatagtgaat 30420
gaattttgaa taaatagtta gaataccaaa atcctggatt gcatttgcaa tcaaatttg 30480

tgaaccgtta aattttgcat gtacttggga tagatataat agaaccgaat tttcattagt 30540
ttaatttata acttactttg ttcaaagaaa aaaaatatct atccaattta cttataataa 30600
aaaataatct atccaagtta cttattataa tcaacttgta aaaaggtaag aatacaaatg 30660
tggtagcgta cgtgtgatta tatgtgacga aatgttatat ctaacaaaag tccaaattcc 30720
catggtaaaa aaaatcaaaa tgcatggcag gctgtttgta accttggaat aagatgttgg 30780
ccaattctgg agccgccacg tacgcaagac tcagggccac gttctcttca tgcaaggata 30840
gtagaacacc actccaccca cctcctatat tagacctttg cccaaccctc cccaactttc 30900
ccatcccatc cacaaagaaa ccgacatttt tatcataaat cagggtttcg tttttgtttc 30960
atcgataaac tcaaaggtga tgattttagg gtcttgtgag tgtgcttttt tgtttgattc 31020
tactgtaggg tttatgttct ttagctcata ggttttgtgt atttcttaga aatgtggctt 31080
ctttaatctc tgggtttgtg actttttgtg tggtttctgt gtttttcata tcaaaaacct 31140
attttttccg agtttttttt tacaaattct tactctcaag cttgaatact tcacatgcag 31200
tgttcttttg tagattttag agttaatgtg ttaaaaagtt tggatttttc ttgcttatag 31260
agcttcttca ctttgatttt gtgggttttt ttgttttaaa ggtgagattt ttgatgaggt 31320
ttttgcttca aagatgtcac ctttctgggt ttgtcttttg aataaagcta tgaactgtca 31380
catggctgac gcaattttgt tactatgtca tgaaagctga cgtttttccg tgttatacat 31440
gtttgcttac acttgcatgc gtcaaaaaaa ttggggcttt ttagttttag tcaaagattt 31500
tacttctctt ttgggattta tgaaggaaag ttgcaaactt tctcaaattt taccattttt 31560
gctttgatgt ttgtttagat tgcgacagaa caaactcata tatgttgaaa tttttgcttg 31620
gttttgtata ggattgtgtc ttttgcttat aaatgttgaa atctgaactt ttttttgtt 31680
tggtttcttt gagcaggaga taaggcgcac caccatggct tctacatctg ctgctcaaga 31740
cgctgctcct tacgagttcc cttctctcac tgagatcaag agggctcttc cttctgagtg 31800
tttcgaggct tctgttcctc tttctctcta ctacaccgct agatctcttg ctcttgctgg 31860
atctctcgct gttgctctct cttacgctag agctttgcct cttgttcagg ctaacgctct 31920
tcttgatgct actctctgca ctggatacgt tcttctccag ggaatcgttt tctggggatt 31980
cttcaccgtt ggtcacgatt gtggacacgg agctttctct agatctcacg tgctcaactt 32040
ctctgttgga accctcatgc actctatcat ccttacccct ttcgagtctt ggaagctctc 32100
tcacagacac caccacaaga acaccggaaa catcgataag gacgagatct tctaccctca 32160
aagagaggct gattctcacc ctgtttctag acaccttgtg atgtctcttg gatctgcttg 32220
gttcgcttac cttttcgctg gattccctcc tagaaccatg aaccacttca acccttggga 32280
ggctatgtat gttagaagag tggctgctgt gatcatctct ctcggagttc ttttcgcttt 32340
cgctggactc tactcttacc tcaccttcgt tcttggattc accactatgg ctatctacta 32400
cttcggacct ctcttcatct tcgctaccat gcttgttgtt accactttcc tccaccacaa 32460
cgatgaggag acaccttggt acgctgattc tgagtggact tacgtgaagg gaaacctctc 32520
ttctgtggac agatcttacg gtgctctcat cgacaacctt agccacaaca tcggaactca 32580
ccagatccac cacctcttcc ctatcatccc tcactacaag ctcaacgatg ctactgctgc 32640
tttcgctaag gctttccctg agcttgttag gaaaaacgct gctcctatca tcccaacttt 32700
cttcaggatg gctgctatgt acgctaagta cggagttgtt gacactgatg ctaagacctt 32760
cactctcaag gaggctaagg ctgctgctaa gactaagtca tcttgatgat taatgaaggc 32820
cgcagatatc agatctggtc gacctagagg atccccggcc gcaaagataa taacaaaagc 32880
ctactatata acgtacatgc aagtattgta tgatattaat gtttttacgt acgtgtaaac 32940
aaaaataatt acgtttgtaa cgtatggtga tgatgtggtg cactaggtgt aggccttgta 33000
ttaataaaaa gaagtttgtt ctatatagag tggtttagta cgacgattta tttactagtc 33060
ggattggaat agagaaccga attcttcaat ccttgctttt gatcaagaat tgaaaccgaa 33120
tcaaatgtaa aagttgatat atttgaaaaa cgtattgagc ttatgaaaat gctaatactc 33180
tcatctgtat ggaaaagtga ctttaaaacc gaacttaaaa gtgacaaaag gggaatatcg 33240
catcaaaccg aatgaaaccg atctacgtag gctcagctga gcttacctaa ggctacgtag 33300
gctcacgtga cgttacgtaa ggctacgtag cgtcacgtga gcttacctaa ctctagctag 33360
cctcacgtga ccttagctaa cactaggtag cgtcagctta gcagatattt ggtgtctaaa 33420
tgtttatttt gtgatatgtt catgtttgaa atggtggttt cgaaaccagg gacaacgttg 33480
ggatctgata gggtgtcaaa gagtattatg gattgggaca atttcggtca tgagttgcaa 33540
attcaagtat atcgttcgat tatgaaaatt ttcgaagaat atcccatttg agagagtctt 33600
tacctcatta atgtttttag attatgaaat tttatcatag ttcatcgtag tctttttggt 33660
gtaaaggctg taaaaagaaa ttgttcactt ttgttttcgt ttatgtgaag gctgtaaaag 33720
attgtaaaag actattttgg tgttttggat aaaatgatag tttttataga ttcttttgct 33780
tttagaagaa atacatttga aattttttcc atgttgagta taaaataccg aaatcgattg 33840
aagatcatag aaatatttta actgaaaaca aatttataac tgattcaatt ctctccattt 33900
ttatacctat ttaaccgtaa tcgattctaa tagatgatcg attttttata taatcctaat 33960
taaccaacgg catgtattgg ataattaacc gatcaactct cacccctaat agaatcagta 34020
ttttccttcg acgttaattg atcctacact atgtaggtca tatccatcgt tttaattttt 34080
ggccaccatt caattctgtc ttgcctttag ggatgtgaat atgaacggcc aaggtaagag 34140
aataaaaata atccaaatta aagcaagaga ggccaagtaa gataatccaa atgtacactt 34200
gtcattgcca aaattagtaa aatactcggc atattgtatt cccacacatt attaaaatac 34260
cgtatatgta ttggctgcat ttgcatgaat aatactacgt gtaagcccaa aagaacccac 34320
gtgtagccca tgcaaagtta acactcacga ccccattcct cagtctccac tatataaacc 34380
caccatcccc aatctcacca aacccaccac acaactcaca actcactctc acaccttaaa 34440
gaaccaatca ccaccaaaaa aagttctttg ctttcgaagt tgccgcaacc taaacaggtt 34500
tttccttctt ctttcttctt attaactacg accttgtcct ttgcctatgt aaaattacta 34560

```
ggttttcatc agttacactg attaagttcg ttatagtgga agataaaatg ccctcaaagc  34620
attttgcagg atatctttga tttttcaaag atatggaact gtagagtttg atagtgttct  34680
tgaatgtggt tgcatgaagt ttttttggtc tgcatgttat tttttcctcg aaatatgttt  34740
tgagtccaac aagtgattca cttgggattc agaaagttgt tttctcaata tgtaacagtt  34800
tttttctatg gagaaaaatc atagggaccg ttggttttgg cttctttaat tttgagctca  34860
gattaaaccc attttacccg gtgttcttgg cagaattgaa aacagtacgt agtaccgcgc  34920
ctaccatgcc acctagtgct gctagtgaag gtggtgttgc tgaacttaga gctgctgaag  34980
ttgctagcta cactagaaag gctgttgacg aaagacctga cctcactata gttggtgacg  35040
ctgtttacga cgctaaggct tttagggacg agcaccctgg tggtgctcac ttcgttagcc  35100
ttttcggagg tagggacgct actgaggctt ttatggaata tcaccgtaga gcttggccta  35160
aggctaggat gtctaagttc ttcgttggtt cacttgacgc tagcgagaag cctactcaag  35220
ctgattcagc ttaccttaga ctttgcgctg aggttaacgc tcttttgcct aagggtagcg  35280
gaggattcgc tcctcctagc tactggctta aggctgctgc tcttgttgtt gctgctgtta  35340
gtatagaggg ttatatgctc cttaggggta agaccctttt gcttagcgtt ttccttggac  35400
tcgtgttcgc ttggatagga cttaatattc agcacgacgc taatcacggt gctcttagta  35460
gacactcagt gattaactac tgcctcggtt acgctcagga ttggataggt ggtaatatgg  35520
tgctttggct tcaagagcac gttgtgatgc accacctcca cactaacgac gttgacgctg  35580
atcctgatca aaaggctcac ggtgttctta gacttaagcc tactgacggt tggatgcctt  35640
ggcacgcact tcaacaactc tatatccttc ctggtgaggc tatgtacgct tttaagcttc  35700
ttttcttgga cgcccttgag cttcttgctt ggaggtggga gggtgagaag attagccctc  35760
ttgctagagc tttgttcgct cctgctgttg cttgtaagct tggattctgg gctagattcg  35820
ttgctctccc tctctggctt caacctactg ttcacactgc tttgtgtatc tgtgctactg  35880
tgtgtactgg tagcttctac ctcgccttct tcttctttat ctctcacaac ttcgacggtg  35940
ttggtagcgt tggacctaag ggatcacttc ctagatcagc tactttcgtt caacgtcagg  36000
ttgagactag ctctaacgtt ggtggttact ggcttggagt tcttaacggt ggacttaact  36060
ttcagataga gcaccacttg ttccctaggc ttcaccactc ttactacgct caaatagctc  36120
ctgtggttag gactcacata gagaagctcg gttttaagta ccgtcacttc cctaccgttg  36180
gatctaacct tagctcaatg cttcagcata tgggtaagat gggaactaga cctggtgctg  36240
agaagggtgg taaggctgag tagtgattaa tgaataattg attgctgctt taatgagata  36300
tgcgagacgc ctatgatcgc atgatatttg ctttcaattc tgttgtgcac gttgtaaaaa  36360
acctgagcat gtgtagctca gatccttacc gccggtttcg gttcattcta atgaatatat  36420
cacccgttac tatcgtattt ttatgaataa tattctccgt tcaatttact gattgtctac  36480
gtagcgtcac ctgacgttac gtaaggctac ctaggctcac gtgacgttac gtaacgctac  36540
gtagcgtcag gtgaggttag ctaacgctag ctagcctcac ctgacgttag gtaaggctac  36600
gtagcgtcac ctgagattag ctaagcctac ctagactcac gtgaccttag gtaacgctac  36660
gtagcgtcaa agctttacaa cgctacacaa aacttataac cgtaatcacc attcattaac  36720
ttaactacta tcacatgcat tcatgaattg aaacgagaag gatgtaaata gttgggaagt  36780
tatctccacg ttgaagagat cgttagcgag agctgaaaga ccgagggagg agacgccgtc  36840
aacacggaca gagtcgtcga ccctcacatg aagtaggagg aatctccgtg aggagccaga  36900
gagacgtctt tggtcttcgg tttcgatcct tgatctgacg gagaagacga gagaagtgcg  36960
actggactcc gtgaggacca acagagtcgt cctcggtttc gatcgtcggt attggtggag  37020
aaggcggagg aatctccgtg acgagccaga gagatgtcgt cggtcttcgg tttcgatcct  37080
tgatctgacg gagaagacga gagaagtgcg acgagactcc gtgaggacca acagagttgt  37140
cctcggtttc gatcgtcggt ttcggcggag aaggcggagg aatctccgtg aggagccaga  37200
gagacgtcgt tggtcttcgg tttcgatcct tgatctgttg gagaagacga gacaagtggg  37260
acgagactca acgacggagt cagagacgtc gtcggtcttc ggtttcggcc gagaaggcgg  37320
agtcggtctt cggtttcggc cgagaaggcg gaggagacgt cttcgatttg ggtctctcct  37380
cttgacgaag aaaacaaaga acacgagaaa taatgagaaa gagaacaaaa gaaaaaaaaa  37440
taaaaataaa aataaaattt ggtcctctta tgtggtgaca cgtggtttga aacccaccaa  37500
ataatcgatc acaaaaaacc taagttaagg atcggtaata acctttctaa ttaattttga  37560
tttatattaa atcactcttt ttatttataa accccactaa attatgcgat attgattgtc  37620
taagtacaaa aattctctcg aattcaatac acatgtttca tatatttagc cctgttcatt  37680
taatattact agcgcatttt taatttaaaa ttttgtaaac ttttttggtc aaagaacatt  37740
tttttaatta gagacagaaa tctagactct ttatttggaa taatagtaat aaagatatat  37800
taggcaatga gtttatgatg ttatgtttat atagtttatt tcattttaaa ttgaaaagca  37860
ttatttttat cgaaatgaat ctagtataca atcaatattt atgtttttttc atcagatact  37920
ttcctatttt ttggcacctt tcatcggact actgatttat ttcaatgtgt atgcatgcat  37980
gagcatgagt atacacatgt cttttaaaat gcatgtaaag cgtaacggac cacaaaagag  38040
gatccataca aatacatctc atcgcttcct ctactattct ccgacacaca cactgagcat  38100
ggtgcttaaa cactctggtg agttctagta cttctgctat gatcgatctc attaccattt  38160
cttaaatttc tctccctaaa tattccgagt tcttgatttt tgataacttc aggttttctc  38220
tttttgataa atctggtctt tccatttttt tttttttgtg gttaatttag tttcctatgt  38280
tcttcgattg tattatgcat gatctgtgtt tggattctgt tagattatgt attggtgaat  38340
atgtatgtgt ttttgcatgt ctggttttgg tcttaaaaat gttcaaatct gatgatttga  38400
ttgaagcttt tttagtgttg gtttgattct tctcaaaact actgttaatt tactatcatg  38460
ttttccaact ttgattcatg atgacacttt tgttctgctt tgttataaaa ttttggttgg  38520
tttgattttg taattatagt gtaattttgt taggaatgaa catgttttaa tactctgttt  38580
tcgatttgtc acacattcga attattaatc gataatttaa ctgaaaattc atggttctag  38640
```

atcttgttgt catcagatta tttgtttcga taattcatca aatatgtagt ccttttgctg 38700
atttgcgact gtttcatttt ttctcaaaat tgttttttgt taagtttatc taacagttat 38760
cgttgtcaaa agtctctttc attttgcaaa atcttctttt ttttttgtt tgtaactttg 38820
ttttttaagc tacacattta gtctgtaaaa tagcatcgag gaacagttgt cttagtagac 38880
ttgcatgttc ttgtaacttc tatttgtttc agtttgttga tgactgcttt gattttgtag 38940
gtcaaaccgc gccatgtctg ctagcggagc tttgttgcct gctatagctt tcgctgctta 39000
cgcttacgct acctacgctt atgctttcga gtggagccac gctaacggaa tcgataacgt 39060
ggatgctaga gagtggattg gagctttgtc tttgagactc cctgcaattg caaccacaat 39120
gtacctcttg ttctgccttg tgggacctag attgatggct aagagggagg cttttgatcc 39180
taagggattt atgctcgctt acaacgctta ccaaaccgct ttcaacgttg tggtgctcgg 39240
aatgttcgct agagagatct ctggattggg acaacctgtt tggggatcta ctatgccttg 39300
gagcgatagg aagtccttca agattttgtt gggagtgtgg ctccactaca acaataagta 39360
cctcgagttg ttggatactg tgttcatggt ggctaggaaa aagaccaagc agctctcttt 39420
cttgcacgtg taccaccacg ctttgttgat ttgggcttgg tggcttgttt gtcacctcat 39480
ggctaccaac gattgcatcg atgcttattt cggagctgct tgcaactctt tcatccacat 39540
cgtgatgtac tcctactacc tcatgtctgc tttgggaatt aggtgccctt ggaagagata 39600
tatcacccag gctcagatgt tgcaattcgt gatcgtgttc gctcacgctg ttttcgtgct 39660
cagacaaaag cactgccctg ttactttgcc ttgggcacaa atgttcgtga tgacaaatat 39720
gttggtgctc ttcggaaact tctacctcaa ggcttactct aacaagtcta ggggagatgg 39780
agcttcttct gttaagcctg ctgagactac tagagcacct tctgtgagaa gaaccaggtc 39840
aaggaagatc gattgatagt taatgaacta agtttgatgt atctgagtgc caacgtttac 39900
tttgtctttc ctttctttta ttggttatga ttagatgttt actatgttct ctctttttcg 39960
ttataaataa agaagttcaa ttcttctata gtttcaaacg cgattttaag cgtttctatt 40020
taggtttaca tgatttcttt tacaaaatca tctttaaaat acagtatatt tttagttttc 40080
ataaaatatt taaagaaatg aaagtttata aacattcact cctattctct aattaaggat 40140
ttgtaaaaca aaaattttgt aagcatatcg atttatgcgt tttgtcttaa ttagctcact 40200
aaataataaa taatagctta tgttgtggga ctgtttaatt acctaactta gaactaaaat 40260
caactctttg tgctagctag cctcagctga cgttacgtaa cgctaggtag cgtcacgtga 40320
cgttagctaa cgctaggtag cgtcagctga gcttacgtaa gcgcttaatt aaagtactga 40380
tatcggtacc aaatcgaatc caaaaattac ggatatgaat ataggcatat ccgtatccga 40440
attatccgtt tgacagctag caacgattgt acaattgctt ctttaaaaaa ggaagaaaga 40500
aagaaagaaa agaatcaaca tcagcgttaa caaacggccc cgttacggcc caaacggtca 40560
tatagagtaa cggcgttaag cgttgaaaga ctcctatcga aatacgtaac cgcaaacgtg 40620
tcatagtcag atcccctctt ccttcaccgc ctcaaacaca aaaataatct tctacagcct 40680
atatatacaa cccccccttc tatctctcct ttctcacaat tcatcatctt tctttctcta 40740
cccccaattt taagaaatcc tctcttctcc tcttcatttt caaggtaaat ctctctctct 40800
ctctctctct ctgttattcc ttgttttaat taggtatgta ttattgctag tttgttaatc 40860
tgcttatctt atgtatgcct tatgtgaata tctttatctt gttcatctca tccgtttaga 40920
agctataaat ttgttgattt gactgtgtat ctacacgtgg ttatgtttat atctaatcag 40980
atatgaattt cttcatattg ttgcgtttgt gtgtaccaat ccgaaatcgt tgattttttt 41040
catttaatcg tgtagctaat tgtacgtata catatggatc tacgtatcaa ttgttcatct 41100
gtttgtgttt gtatgtatac agatctgaaa acatcacttc tctcatctga ttgtgttgtt 41160
acatacatag atatagatct gttatatcat ttttttttatt aattgtgtat atatatatgt 41220
gcatagatct ggattacatg attgtgatta tttacatgat tttgttattt acgtatgtat 41280
atatgtagat ctggactttt tggagttgtt gacttgattg tatttgtgtg tgtatatgtg 41340
tgttctgatc ttgatatgtt atgtatgtgc agctgaacca tggcggcggc aacaacaaca 41400
acaacaacat cttcttcgat ctccttctcc accaaaccat ctccttcctc ctccaaatca 41460
ccattaccaa tctccagatt ctccctccca ttctccctaa accccaacaa atcatcctcc 41520
tcctcccgcc gccgcggtat caaatccagc tctccctcct ccatctccgc cgtgctcaac 41580
acaaccacca atgtcacaac cactccctct ccaaccaaac ctaccaaacc cgaaacattc 41640
atctcccgat tcgctccaga tcaaccccgc aaaggcgctg atatcctcgt cgaggcttta 41700
gaacgtcaag gcgtagaaac cgtattcgct taccctggag gtacatcaat ggagattcac 41760
caagccttaa cccgctcttc ctcaatccgt aacgtccttc ctcgtcacga acaaggaggt 41820
gtattcgcag cagaaggata cgctcgatcc tcaggtaaac caggtatctg tatagccact 41880
tcaggtcccg gagctacaaa tctcgttagc ggattagccg atgcgttgtt agatagtgtt 41940
cctcttgtag caatcacagg acaagtccct cgtcgtatga ttggtacaga tgcgtttcaa 42000
gagactccga ttgttgaggt aacgcgttcg attacgaagc ataactatct tgtgatggat 42060
gttgaagata tcccaaggat tattgaagag gctttctttt tagctacttc tggtagacct 42120
ggacctgttt tggttgatgt tcctaaagat attcaacaac agcttgcgat tcctaattgg 42180
gaacaggcta tgagattacc tggttatatg tctaggatgc ctaaacctcc ggaagattct 42240
catttggagc agattgttag gttgatttct gagtctaaga agcctgtgtt gtatgttggt 42300
ggtggttgtc ttaattctag cgatgaattg ggtaggtttg ttgagcttac gggcatccct 42360
gttgcgagta cgttgatggg gctgggatct tatccttgtg atgatgagtt gtcgttacat 42420
atgcttggaa tgcatgggac tgtgtatgca aattacgctg tggagcatag tgatttgttg 42480
ttggcgtttg gggtaaggtt tgatgatcgt gtcacgggta aacttgaggc ttttgctagt 42540
agggctaaga ttgttcatat tgatattgac tcggctgaga ttgggaagaa taagactcct 42600
catgtgtctg tgtgtggtga tgttaagctg gctttgcaag ggatgaataa ggttcttgag 42660
aaccgagcgg aggagcttaa acttgatttt ggagtttgga ggaatgagtt gaacgtacag 42720

aaacagaagt ttccgttgag ctttaagacg tttggggaag ctattcctcc acagtatgcg 42780
attaaggtcc ttgatgagtt gactgatgga aaagccataa taagtactgg tgtcgggcaa 42840
catcaaatgt gggcggcgca gttctacaat tacaagaaac caaggcagtg gctatcatca 42900
ggaggccttg gagctatggg atttggactt cctgctgcga ttggagcgtc tgttgctaac 42960
cctgatgcga tagttgtgga tattgacgga gatggaagtt ttataatgaa tgtgcaagag 43020
ctagccacta ttcgtgtaga gaatcttcca gtgaaggtac ttttattaaa caaccagcat 43080
cttggcatgg ttatgcaatg ggaagatcgg ttctacaaag ctaaccgagc tcacacattt 43140
ctcggggacc cggctcagga ggacgagata ttcccgaaca tgttgctgtt tgcagcagct 43200
tgcgggattc cagcggcgag ggtgacaaag aaagcagatc tccgagaagc tattcagaca 43260
atgctggata caccaggacc ttacctgttg gatgtgattt gtccgcacca agaacatgtg 43320
ttgccgatga tcccgaatgg tggcactttc aacgatgtca taacggaagg agatggccgg 43380
attaaatact gagagatgaa accggtgatt atcagaacct tttatggtct ttgtatgcat 43440
atggtaaaaa aacttagttt gcaatttcct gtttgttttg gtaatttgag tttcttttag 43500
ttgttgatct gcctgctttt tggtttacgt cagactacta ctgctgttgt tgtttggttt 43560
cctttctttc attttataaa taaataatcc ggttcggttt actccttgtg actggctcag 43620
tttggttatt gcgaaatgcg aatggtaaat tgagtaattg aaattcgtta ttagggttct 43680
aagctgtttt aacagtcact gggttaatat ctctcgaatc ttgcatggaa aatgctctta 43740
ccattggttt ttaattgaaa tgtgctcata tgggccgtgg tttccaaatt aaataaaact 43800
acgatgtcat cgagaagtaa aatcaactgt gtccacatta tcagttttgt gtatacgatg 43860
aaatagggta attcaaaatc tagcttgata tgccttttgg ttcattttaa ccttctgtaa 43920
acatttttc agattttgaa caagtaaatc caaaaaaaaa aaaaaaaatc tcaactcaac 43980
actaaattat tttaatgtat aaaagatgct taaaacattt ggcttaaaag aaagaagcta 44040
aaaacataga gaactcttgt aaattgaagt atgaaaatat actgaattgg gtattatatg 44100
aatttttctg atttaggatt cacatgatcc aaaaaggaaa tccagaagca ctaatcagac 44160
attggaagta ggattaatca gtgatcagta actattaaat tcaattaacc gcggacatct 44220
acatttttga attgaaaaaa aattggtaat tactctttct ttttctccat attgaccatc 44280
atactcattg ctgatccatg tagatttccc ggacatgaag ccatatatct gaccctactc 44340
cacaaatata tttttattta taaaaaggtg gccattgtat actatgtgtg cgtatacagg 44400
aataaaaatg tgtcaatgta tatgtaaact gattccatct tatatgtaat gtgcgtgtgt 44460
aaatgaagat actagtatcc atgtgtcgcc tacttgattt gttcaactgt aactcataat 44520
atctcaagat tctttctttt ttttctacga atatcgcaat ctataatacc attaaattat 44580
tgtaacaaaa ttggttgaca tttataaaat gaaaaagaag agaagagcat ttaaacacga 44640
ctgatgaaag tccaatgtag ctagataaac cacgcgtggt ggtcaatgcg ttccattcca 44700
aaaggatccg agttcgaatc cgcaccacac cagattttca ctgcgcgtgg ccatgaagct 44760
ttcgcattct cgctcctgag aatggttctc cattttttt ttccagtgta gctagatacc 44820
ggtctgaatc taggtttata atatgctgac aatgtaatga taattaatac atcaaaacat 44880
gtgtttctga accaaaataa aaactttttt 44910

<210> 281
<211> 43757
<212> DNA
<213> Artificial Sequence

<220>
<223> T-DNA insertion in LBFLFK Locus 1, including left and right border sequences

<400> 281
ccagtcagca tcatcacacc aaaagttagg cccgaatagt ttgaaattag aaagctcgca 60
attgaggtct acaggccaaa ttcgctctta gccgtacaat attactcacc ggtgcgatgc 120
cccccatcgt aggtgaaggt ggaaattaat ggcgcgcctg atcactgatt agtaactatt 180
acgtaagcct acgtagcgtc acgtgacgtt agctaacgct acgtagcctc agctgacgtt 240
acgtaagcct acgtagcgtc acgtgagctt agctaacgct acctaggctc agctgacgtt 300
acgtaacgct agctagcgtc actcctgcag caaatttaca cattgccact aaacgtctaa 360
acccttgtaa tttgttttg ttttactatg tgtgttatgt atttgatttg cgataaattt 420
ttatatttgg tactaaattt ataacacctt ttatgctaac gtttgccaac acttagcaat 480
ttgcaagttg attaattgat tctaaattat ttttgtcttc taaatacata tactaatcaa 540
ctggaaatgt aaatatttgc taatatttct actataggag aattaaagtg agtgaatatg 600
gtaccacaag gtttggagat ttaattgttg caatgctgca tggatggcat atacaccaaa 660
cattcaataa ttcttgagga taataatggt accacacaag atttgaggtg catgaacgtc 720
acgtggacaa aaggtttagt aatttttcaa gacaacaatg ttaccacaca caagttttga 780
ggtgcatgca tggatgccct gtggaaagtt taaaaatatt ttggaaatga tttgcatgga 840
agccatgtgt aaaaccatga catccacttg gaggatgcaa taatgaagaa aactacaaat 900
ttacatgcaa ctagttatgc atgtagtcta tataatgagg attttgcaat actttcattc 960
atacacactc actaagtttt acacgattat aatttcttca tagccagtac tgtttaagct 1020
tcactgtctc tgaatcggca aaggtaaacg tatcaattat tctacaaacc cttttatttt 1080
tcttttgaat taccgtcttc attggttata tgataacttg ataagtaaag cttcaataat 1140
tgaatttgat ctgtgttttt ttggccttaa tactaaatcc ttacataagc tttgttgctt 1200

```
ctcctcttgt gagttgagtg ttaagttgta ataatggttc actttcagct ttagaagaaa   1260
ccatggaagt tgttgagagg ttctacggag agttggatgg aaaggtttcc caaggagtga   1320
acgctttgtt gggatctttc ggagttgagt tgactgatac cccaactact aagggattgc   1380
cactcgttga ttctccaact ccaattgtgt tgggagtgtc tgtttacttg accatcgtga   1440
tcggaggatt gctttggatc aaggctagag atctcaagcc aagagcttct gagccattct   1500
tgttgcaagc tttggtgttg gtgcacaact tgttctgctt cgctttgtct ctttacatgt   1560
gcgtgggtat cgcttaccaa gctatcacct ggagatattc cttgtgggga aacgcttata   1620
acccaaagca caaggagatg gctatcctcg tttacctctt ctacatgtcc aagtacgtgg   1680
agttcatgga taccgtgatc atgatcctca agagatccac cagacagatt tctttcctcc   1740
acgtgtacca ccactcttct atctccctta tctggtgggc tattgctcac cacgctccag   1800
gaggagaggc ttattggagt gctgctctca actctggagt gcacgtgttg atgtacgctt   1860
actacttctt ggctgcttgc ttgagatctt ccccaaagct caagaacaag tacctcttct   1920
ggggaagata cctcacccaa ttccagatgt tccagttcat gctcaacttg gtgcaagctt   1980
actacgatat gaaaaccaac gctccatatc cacaatggct catcaagatc ctcttctact   2040
acatgatctc cctcttgttc ctcttcggaa acttctacgt gcaaaagtac atcaagccat   2100
ccgatggaaa gcaaaaggga gctaagaccg agtgatcgac aagctcgagt ttctccataa   2160
taatgtgtga gtagttccca gataagggaa ttagggttcc tatagggttt cgctcatgtg   2220
ttgagcatat aagaaaccct tagtatgtat ttgtatttgt aaaatacttc tatcaataaa   2280
atttctaatt cctaaaacca aaatccagta ctaaaatcca gatcccccga attaattcgg   2340
cgttaattca gctagctagc ctcagctgac gttacgtaac gctaggtagc gtcacgtgac   2400
gttagctaac gctaggtagc gtcagctgag cttacgtaag cgcttagcag atatttggtg   2460
tctaaatgtt tattttgtga tatgttcatg tttgaaatgg tggtttcgaa accagggaca   2520
acgttgggat ctgatagggt gtcaaagagt attatggatt gggacaattt cggtcatgag   2580
ttgcaaattc aagtatatcg ttcgattatg aaaattttcg aagaatatcc catttgagag   2640
agtctttacc tcattaatgt ttttagatta tgaaatttta tcatagttca tcgtagtctt   2700
tttggtgtaa aggctgtaaa aagaaattgt tcacttttgt tttcgtttat gtgaaggctg   2760
taaaagattg taaaagacta ttttggtgtt ttggataaaa tgatagtttt tatagattct   2820
tttgctttta gaagaaatac atttgaaatt ttttccatgt tgagtataaa ataccgaaat   2880
cgattgaaga tcatagaaat attttaactg aaaacaaatt tataactgat tcaattctct   2940
ccatttttat acctatttaa ccgtaatcga ttctaataga tgatcgattt tttatataat   3000
cctaattaac caacggcatg tattggataa ttaaccgatc aactctcacc cctaatagaa   3060
tcagtatttt ccttcgacgt taattgatcc tacactatgt aggtcatatc catcgtttta   3120
atttttggcc accattcaat tctgtcttgc ctttagggat gtgaatatga acggccaagg   3180
taagagaata aaaataatcc aaattaaagc aagagaggcc aagtaagata atccaaatgt   3240
acacttgtca ttgccaaaat tagtaaaata ctcggcatat tgtattccca cacattatta   3300
aaataccgta tatgtattgg ctgcatttgc atgaataata ctacgtgtaa gcccaaaaga   3360
acccacgtgt agcccatgca aagttaacac tcacgacccc attcctcagt ctccactata   3420
taaacccacc atccccaatc tcaccaaacc caccacacaa ctcacaactc actctcacac   3480
cttaaagaac caatcaccac caaaaaattt cacgatttgg aatttgattc ctgcgatcac   3540
aggtatgaca ggttagattt tgttttgtat agttgtatac atacttcttt gtgatgtttt   3600
gtttacttaa tcgaattttt ggagtgtttt aaggtctctc gtttagaaat cgtggaaaat   3660
atcactgtgt gtgtgttctt atgattcaca gtgtttatgg gtttcatgtt ctttgtttta   3720
tcattgaatg ggaagaaatt tcgttgggat acaaatttct catgttctta ctgatcgtta   3780
ttaggagttt ggggaaaaag gaagagtttt tttggttggt tcgagtgatt atgaggttat   3840
ttctgtattt gatttatgag ttaatggtcg ttttaatgtt gtagaccatg ggaaaaggat   3900
ctgagggaag atctgctgct agagagatga ctgctgaggc taacggagat aagagaaaga   3960
ccatcctcat tgagggagtg ttgtacgatg ctaccaactt caaacaccca ggaggttcca   4020
ttattaactt cctcaccgag ggagaagctg gagttgatgc tacccaagct tacagagagt   4080
tccatcagag atccggaaag gctgataagt acctcaagtc cctcccaaag ttggatgctt   4140
ctaaggtgga gtctaggttc tctgctaagg agcaggctag aagggacgct atgaccaggg   4200
attacgctgc tttcagagag gagttggttg ctgagggata cttcgatcca tctatcccac   4260
acatgatcta cagagtggtg gagattgtgg ctttgttcgc tttgtctttc tggttgatgt   4320
ctaaggcttc tccaacctct ttggttttgg gagtggtgat gaacggaatc gctcaaggaa   4380
gatgcggatg ggttatgcac gagatgggac acggatcttt cactggagtt atctggctcg   4440
atgataggat gtgcgagttc ttctacggag ttggatgtgg aatgtctgga cactactgga   4500
agaaccagca ctctaagcac cacgctgctc caaacagatt ggagcacgat gtggatttga   4560
acaccttgcc actcgttgct ttcaacgaga gagttgtgag gaaggttaag ccaggatctt   4620
tgttggcttt gtggctcaga gttcaggctt atttgttcgc tccagtgtct tgcttgttga   4680
tcggattggg atggaccttg tacttgcacc caagatatat gctcaggacc aagagacaca   4740
tggagtttgt gtggatcttc gctagatata tcggatggtt ctccttgatg ggagctttgg   4800
gatattctcc tggaacttct gtgggaatgt acctctgctc tttcggactt ggatgcatct   4860
acatcttcct ccaattcgct gtgtctcaca cccacttgcc agttaccaac ccagaggatc   4920
aattgcactg gcttgagtac gctgctgatc acaccgtgaa catctctacc aagtcttggt   4980
tggttacctg gtggatgtct aacctcaact tccaaatcga gcaccacttg ttcccaaccg   5040
ctccacaatt caggttcaag gagatctctc caagagttga ggctctcttc aagagacaca   5100
acctccctta ctacgatttg ccatacacct ctgctgtttc tactaccttc gctaacctct   5160
actctgttgg acactctgtt ggagctgata ccaagaagca ggattgactg ctttaatgag   5220
atatgcgaga cgcctatgat cgcatgatat ttgctttcaa ttctgttgtg cacgttgtaa   5280
```

aaaacctgag catgtgtagc tcagatcctt accgccggtt tcggttcatt ctaatgaata 5340
tatcacccgt tactatcgta tttttatgaa taatattctc cgttcaattt actgattgtc 5400
tacgtaggct cagctgagct tacctaaggc tacgtaggct cacgtgacgt tacgtaaggc 5460
tacgtagcgt cacgtgagct tacctaactc tagctagcct cacgtgacct tagctaacac 5520
taggtagcgt cagctcgacg gcccggactg tatccaactt ctgatctttg aatctctctg 5580
ttccaacatg ttctgaagga gttctaagac ttttcagaaa gcttgtaaca tgctttgtag 5640
actttctttg aattactctt gcaaactctg attgaaccta cgtgaaaact gctccagaag 5700
ttctaaccaa attccgtctt gggaaggccc aaaatttatt gagtacttca gtttcatgga 5760
cgtgtcttca aagatttata acttgaaatc ccatcatttt taagagaagt tctgttccgc 5820
aatgtcttag atctcattga aatctacaac tcttgtgtca gaagttcttc cagaatcaac 5880
ttgcatcatg gtgaaaatct ggccagaagt tctgaacttg tcatatttct taacagttag 5940
aaaaatttct aagtgtttag aattttgact tttccaaagc aaacttgact tttgactttc 6000
ttaataaaac aaacttcata ttctaacatg tcttgatgaa atgtgattct tgaaatttga 6060
tgttgatgca aaagtcaaag tttgactttt cagtgtgcaa ttgaccattt tgctcttgtg 6120
ccaattccaa acctaaattg atgtatcagt gctgcaaact tgatgtcatg gaagatctta 6180
tgagaaaatt cttgaagact gagaggaaaa attttgtagt acaacacaaa gaatcctgtt 6240
tttcatagtc ggactagaca cattaacata aaacaccact tcattcgaag agtgattgaa 6300
gaaggaaatg tgcagttacc tttctgcagt tcataagagc aacttacaga cacttttact 6360
aaaatactac aaagaggaag attttaacaa cttagagaag taatgggagt taaagagcaa 6420
cacattaagg gggagtgtta aaattaatgt gttgtaacca ccactacctt tagtaagtat 6480
tataagaaaa ttgtaatcat cacattataa ttattgtcct tatttaaaat tatgataaag 6540
ttgtatcatt aagattgaga aaaccaaata gtcctcgtct tgatttttga attattgttt 6600
tctatgttac ttttcttcaa gcctatataa aaactttgta atgctaaatt gtatgctgga 6660
aaaaaatgtg taatgaattg aatagaaatt atggtatttc aaagtccaaa atccatcaat 6720
agaaatttag tacaaaacgt aactcaaaaa tattctctta ttttaaattt tacaacaata 6780
taaaaatatt ctcttatttt aaattttaca ataatataat ttatcacctg tcacctttag 6840
aataccacca acaatattaa tacttagata ttttattctt aataattttg agatctctca 6900
atatatctga tatttatttt atatttgtgt catattttct tatgttttag agttaaccct 6960
tatatcttgg tcaaactagt aattcaatat atgagtttgt gaaggacaca ttgacatctt 7020
gaaacattgg ttttaacctt gttggaatgt taaaggtaat aaaacattca gaattatgac 7080
catctattaa tatacttcct ttgtctttta aaaaagtgtg catgaaaatg ctctatggta 7140
agctagagtg tcttgctggc ctgtgtatat caattccatt tccagatggt agaaactgcc 7200
actacgaata attagtcata agacacgtat gttaacacac gtccccttgc atgtttttg 7260
ccatatattc cgtctctttc tttttcttca cgtataaaac aatgaactaa ttaatagagc 7320
gatcaagctg aacagttctt tgctttcgaa gttgccgcaa cctaaacagg tttttccttc 7380
ttctttcttc ttattaacta cgaccttgtc ctttgcctat gtaaaattac taggttttca 7440
tcagttacac tgattaagtt cgttatagtg gaagataaaa tgccctcaaa gcattttgca 7500
ggatatcttt gatttttcaa agatatggaa ctgtagagtt tgatagtgtt cttgaatgtg 7560
gttgcatgaa gtttttttgg tctgcatgtt atttttttcct cgaaatatgt tttgagtcca 7620
acaagtgatt cacttgggat tcagaaagtt gttttctcaa tatgtaacag tttttttcta 7680
tggagaaaaa tcatagggac cgttggtttt ggcttcttta attttgagct cagattaaac 7740
ccattttacc cggtgttctt ggcagaattg aaaacagtac gtagtaccgc gcctaccatg 7800
tgtgttgaga ccgagaacaa cgatggaatc cctactgtgg agatcgcttt cgatggagag 7860
agagaaagag ctgaggctaa cgtgaagttg tctgctgaga agatggaacc tgctgctttg 7920
gctaagacct tcgctagaag atacgtggtt atcgagggag ttgagtacga tgtgaccgat 7980
ttcaaacatc ctggaggaac cgtgattttc tacgctctct ctaacactgg agctgatgct 8040
actgaggctt tcaaggagtt ccaccacaga tctagaaagg ctaggaaggc tttggctgct 8100
ttgccttcta gacctgctaa gaccgctaaa gtggatgatg ctgagatgct ccaggatttc 8160
gctaagtgga gaaaggagtt ggagagggac ggattcttca agccttctcc tgctcatgtt 8220
gcttacagat tcgctgagtt ggctgctatg tacgctttgg gaacctactt gatgtacgct 8280
agatacgttg tgtcctctgt gttggtttac gcttgcttct tcggagctag atgtggatgg 8340
gttcaacacg agggaggaca ctcttctttg accggaaaca tctggtggga taagagaatc 8400
caagctttca ctgctggatt cggattggct ggatctggag atatgtggaa ctccatgcac 8460
aacaagcacc acgctactcc tcaaaaagtg aggcacgata tggatttgga taccactcct 8520
gctgttgctt tcttcaacac cgctgtggag gataatagac ctaggggatt ctctaagtac 8580
tggctcagat tgcaagcttg gaccttcatt cctgtgactt ctggattggt gttgctcttc 8640
tggatgttct tcctccaccc ttctaaggct ttgaagggag gaaagtacga ggagcttgtg 8700
tggatgttgg ctgctcacgt gattagaacc tggaccatta aggctgttac tggattcacc 8760
gctatgcaat cctacggact cttcttggct acttcttggg tttccggatg ctacttgttc 8820
gctcacttct ctacttctca cacccacttg gatgttgttc ctgctgatga gcacttgtct 8880
tgggttaggt acgctgtgga tcacaccatt gatatcgatc cttctcaggg atgggttaac 8940
tggttgatgg gatacttgaa ctgccaagtg attcaccacc tcttcccttc tatgcctcaa 9000
ttcagacaac ctgaggtgtc cagaagattc gttgctttcg ctaagaagtg gaacctcaac 9060
tacaaggtga tgacttatgc tggagcttgg aaggctactt tgggaaacct cgataatgtg 9120
ggaaagcact actacgtgca cggacaacac tctggaaaga ccgcttgatt aatgaaggcc 9180
gcctcgaccg taccccctgc agatagacta tactatgttt tagcctgcct gctggctagc 9240
tactatgtta tgttatgttg taaaataaac acctgctaag gtatatctat ctatatttta 9300
gcatggcttt ctcaataaat tgtctttcct tatcgtttac tatcttatac ctaataatga 9360

aataataata tcacatatga ggaacggggc aggtttaggc atatatatac gagtgtaggg 9420
cggagtgggg ctacgtagcg tcacgtgacg ttacctaagc ctaggtagcc tcagctgacg 9480
ttacgtaacg ctaggtaggc tcagctgaca cgggcaggac atagggacta ctacaagcat 9540
agtatgcttc agacaaagag ctaggaaaga actcttgatg gaggttaaga gaaaaaagtg 9600
ctagaggggc atagtaatca aacttgtcaa aaccgtcatc atgatgaggg atgacataat 9660
ataaaaagtt gactaaggtc ttggtagtac tctttgatta gtattatata ttggtgagaa 9720
catgagtcaa gaggagacaa gaaaccgagg aaccatagtt tagcaacaag atggaagttg 9780
caaagttgag ctagccgctc gattagttac atctcctaag cagtactaca aggaatggtc 9840
tctatacttt catgtttagc acatggtagt gcggattgac aagttagaaa cagtgcttag 9900
gagacaaaga gtcagtaaag gtattgaaag agtgaagttg atgctcgaca ggtcaggaga 9960
agtccctccg ccagatggtg actaccaagg ggttggtatc agctgagacc caaataagat 10020
tcttcggttg aaccagtggt tcgaccgaga ctcttagggt gggatttcac tgtaagattt 10080
gtgcattttg ttgaatataa attgacaatt ttttttattt aattatagat tatttagaat 10140
gaattacata tttagtttct aacaaggata gcaatggatg ggtatgggta caggttaaac 10200
atatctatta cccacccatc tagtcgtcgg gttttacacg tacccacccg tttacataaa 10260
ccagaccgga attttaaacc gtacccgtcc gttagcgggt ttcagattta cccgtttaat 10320
cgggtaaaac ctgattacta aatatatatt ttttatttga taaacaaaac aaaaatgtta 10380
atattttcat attggatgca attttaagaa acacatattc ataaatttcc atatttgtag 10440
gaaaataaaa agaaaaatat attcaagaac acaaatttca ccgacatgac ttttattaca 10500
gagttggaat tagatctaac aattgaaaaa ttaaaattaa gatagaatat gttgaggaac 10560
atgacatagt ataatgctgg gttacccgtc gggtaggtat cgaggcggat actactaaat 10620
ccatcccact cgctatccga taatcactgg tttcgggtat acccattccc gtcaacaggc 10680
ctttttaacc ggataatttc aacttatagt gaatgaattt tgaataaata gttagaatac 10740
caaaatcctg gattgcattt gcaatcaaat tttgtgaacc gttaaatttt gcatgtactt 10800
gggatagata taatagaacc gaattttcat tagtttaatt tataacttac tttgttcaaa 10860
gaaaaaaaat atctatccaa tttacttata ataaaaaata atctatccaa gttacttatt 10920
ataatcaact tgtaaaaagg taagaataca aatgtggtag cgtacgtgtg attatatgtg 10980
acgaaatgtt atatctaaca aaagtccaaa ttcccatggt aaaaaaaatc aaaatgcatg 11040
gcaggctgtt tgtaaccttg gaataagatg ttggccaatt ctggagccgc cacgtacgca 11100
agactcaggg ccacgttctc ttcatgcaag gatagtagaa caccactcca cccacctcct 11160
atattagacc tttgcccaac cctccccaac tttcccatcc catccacaaa gaaaccgaca 11220
tttttatcat aaatctggtg cttaaacact ctggtgagtt ctagtacttc tgctatgatc 11280
gatctcatta ccatttctta aatttctctc cctaaatatt ccgagttctt gatttttgat 11340
aacttcaggt tttctctttt tgataaatct ggtctttcca tttttttttt ttgtggttaa 11400
tttagtttcc tatgttcttc gattgtatta tgcatgatct gtgtttggat tctgttagat 11460
tatgtattgg tgaatatgta tgtgtttttg catgtctggt tttggtctta aaaatgttca 11520
aatctgatga tttgattgaa gctttttttag tgttggtttg attcttctca aaactactgt 11580
taatttacta tcatgttttc caactttgat tcatgatgac acttttgttc tgctttgtta 11640
taaaattttg gttggtttga ttttgtaatt atagtgtaat tttgttagga atgaacatgt 11700
tttaatactc tgttttcgat ttgtcacaca ttcgaattat taatcgataa tttaactgaa 11760
aattcatggt tctagatctt gttgtcatca gattatttgt ttcgataatt catcaaatat 11820
gtagtccttt tgctgatttg cgactgtttc attttttctc aaaattgttt tttgttaagt 11880
ttatctaaca gttatcgttg tcaaaagtct ctttcatttt gcaaaatctt cttttttttt 11940
ttgtttgtaa ctttgttttt taagctacac atttagtctg taaaatagca tcgaggaaca 12000
gttgtcttag tagacttgca tgttcttgta acttctattt gtttcagttt gttgatgact 12060
gctttgattt tgtaggtcaa aggcgcaccc taccatggat gcttataacg ctgctatgga 12120
taagattgga gctgctatca tcgattggag tgatccagat ggaaagttca gagctgatag 12180
ggaggattgg tggttgtgcg atttcagatc cgctatcacc attgctctca tctacatcgc 12240
tttcgtgatc ttgggatctg ctgtgatgca atctctccca gctatggacc catacсctat 12300
caagttcctc tacaacgtgt ctcaaatctt cctctgcgct tacatgactg ttgaggctgg 12360
attcctcgct tataggaacg gatacaccgt tatgccatgc aaccacttca acgtgaacga 12420
tccaccagtt gctaacttgc tctggctctt ctacatctcc aaagtgtggg atttctggga 12480
taccatcttc attgtgctcg gaaagaagtg gagacaactc tctttcttgc acgtgtacca 12540
ccacaccacc atcttcctct tctactggtt gaacgctaac gtgctctacg atggagatat 12600
cttcttgacc atcctcctca acggattcat tcacaccgtg atgtacacct actacttcat 12660
ctgcatgcac accaaggatt ctaagaccgg aaagtctttg ccaatctggt ggaagtcatc 12720
tttgaccgct ttccaactct tgcaattcac catcatgatg tcccaagcta cctacttggt 12780
tttccacgga tgcgataagg tttccctcag aatcaccatc gtgtacttcg tgtacattct 12840
ctccctttc ttcctcttcg ctcagttctt cgtgcaatcc tacatggctc caaagaagaa 12900
gaagtccgct tgatgttaat gaaggccgca gatatcagat ctggtcgacc tagaggatcc 12960
ccggccgcaa agataataac aaaagcctac tatataacgt acatgcaagt attgtatgat 13020
attaatgttt ttacgtacgt gtaaacaaaa ataattacgt ttgtaacgta tggtgatgat 13080
gtggtgcact aggtgtaggc cttgtattaa taaaaagaag tttgttctat atagagtggt 13140
ttagtacgac gatttattta ctagtcggat tggaatagag aaccgaattc ttcaatcctt 13200
gcttttgatc aagaattgaa accgaatcaa atgtaaaagt tgatatattt gaaaaacgta 13260
ttgagcttat gaaaatgcta atactctcat ctgtatggaa aagtgacttt aaaaccgaac 13320
ttaaaagtga caaaagggga atatcgcatc aaaccgaatg aaaccgatct acgtaggctc 13380
agctgagctt agctaagcct acctagcctc acgtgagatt atgtaaggct aggtagcgtc 13440

acgtgacgtt acctaacact agctagcgtc agctgagctt agctaaccct acgtagcctc 13500
acgtgagctt acctaacgct acgtagcctc acgtgactaa ggatgaccta cccattcttg 13560
agacaaatgt tacattttag tatcagagta aaatgtgtac ctataactca aattcgattg 13620
acatgtatcc attcaacata aaattaaacc agcctgcacc tgcatccaca tttcaagtat 13680
tttcaaaccg ttcggctcct atccaccggg tgtaacaaga cggattccga atttggaaga 13740
ttttgactca aattcccaat ttatattgac cgtgactaaa tcaactttaa cttctataat 13800
tctgattaag ctcccaattt atattcccaa cggcactacc tccaaaattt atagactctc 13860
atcccctttt aaaccaactt agtaaacgtt tttttttaa ttttatgaag ttaagttttt 13920
accttgtttt taaaaagaat cgttcataag atgccatgcc agaacattag ctacacgtta 13980
cacatagcat gcagccgcgg agaattgttt ttcttcgcca cttgtcactc ccttcaaaca 14040
cctaagagct tctctctcac agcacacaca tacaatcaca tgcgtgcatg cattattaca 14100
cgtgatcgcc atgcaaatct cctttatagc ctataaatta actcatcggc ttcactcttt 14160
actcaaacca aaactcatca atacaaacaa gattaaaaac atttcacgat ttggaatttg 14220
attcctgcga tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt 14280
ctttgtgatg ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag 14340
aaatcgtgga aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca 14400
tgttctttgt tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt 14460
cttactgatc gttattagga gtttggggaa aaaggaagag ttttttggt tggttcgagt 14520
gattatgagg ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac 14580
cgccatggct attttgaacc ctgaggctga ttctgctgct aacctcgcta ctgattctga 14640
ggctaagcaa agacaattgg ctgaggctgg atacactcac gttgagggtg ctcctgctcc 14700
tttgcctttg gagttgcctc acttctctct cagagatctc agagctgcta ttcctaagca 14760
ctgcttcgag agatctttcg tgacctccac ctactacatg atcaagaacg tgttgacttg 14820
cgctgctttg ttatacgctg ctaccttcat tgatagagct ggagctgctg cttatgtttt 14880
gtggcctgtg tactggttct tccagggatc ttacttgact ggagtgtggg ttatcgctca 14940
cgagtgtgga caccaggctt attgctcttc tgaggtggtg aacaacttga ttggactcgt 15000
gttgcactct gctttgttgg tgccttacca ctcttggaga atctctcaca gaaagcacca 15060
ctccaacact ggatcttgcg agaacgatga ggttttcgtt cctgtgacca gatctgtgtt 15120
ggcttcttct tggaacgaga ccttggagga ttctcctctc taccaactct accgtatcgt 15180
gtacatgttg gttgttggat ggatgcctgg atacctcttc ttcaacgcta ctggacctac 15240
taagtactgg ggaaagtcta ggtctcactt caacccttac tccgctatct atgctgatag 15300
ggagaggtgg atgatcgtgc tctccgatat ttcttggtg gctatgttgg ctgttttggc 15360
tgctttggtg cacactttct ccttcaacac gatggtgaag ttctacgtgg tgccttactt 15420
cattgtgaac gcttacttgg tgttgattac ctacctccaa cacaccgata cctacatccc 15480
tcacttcaga gagggagagt ggaattggtt gagaggagct ttgtgcactg tggatagatc 15540
atttggtcca ttcctcgatt ctgtggtgca tagaatcgtg gatacccacg tttgccacca 15600
tatcttctcc aagatgcctt tctatcactg cgaggaggct accaacgcta ttaagcctct 15660
cctcggaaag ttctacttga aggatactac tcctgttcct gttgctctct ggagatctta 15720
cacccactgc aagttcgttg aggatgatgg aaaggtggtg ttctacaaga acaagttata 15780
gttaatgaat aattgattgg ttcgagtatt atggcattgg gaaaactgtt tttcttgtac 15840
catttgttgt gcttgtaatt tactgtgttt tttattcggt tttcgctatc gaactgtgaa 15900
atggaaatgg atggagaaga gttaatgaat gatatggtcc ttttgttcat tctcaaatta 15960
atattatttg tttttctct tatttgttgt gtgttgaatt tgaaattata agagatatgc 16020
aaacattttg ttttgagtaa aaatgtgtca aatcgtggcc tctaatgacc gaagttaata 16080
tgaggagtaa aacacttgta gttgtaccat tatgcttatt cactaggcaa caaatatatt 16140
ttcagaccta gaaaagctgc aaatgttact gaatacaagt atgtcctctt gtgttttaga 16200
catttatgaa ctttccttta tgtaattttc cagaatcctt gtcagattct aatcattgct 16260
ttataattat agttatactc atggatttgt agttgagtat gaaaatattt tttaatgcat 16320
tttatgactt gccaattgat tgacaacatg catcaatcta gctagcctca gctgacgtta 16380
cgtaacgcta ggtagcgtca cgtgacgtta gctaacgcta ggtagcgtca gctgagctta 16440
cgtaagcgca cagatgaata ctagctgttg ttcacagttc tagtgtctcc tcattacgtg 16500
aattcaagct acgatcacta tctcaactcc tacataaaca tcagaatgct acaaaactat 16560
gcacaaaaac aaaagctaca tctaatacgt gaatcaatta ctctcatcac aagaaagaag 16620
atttcaatca ccgtcgagaa ggaggattca gttaattgaa tcaaagttcc gatcaaactc 16680
gaagactggt gagcacgagg acgacgaaga agagtgtctc gaagatacaa caagcaagaa 16740
atctactgag tgacctcctg aagttattgg cgcgattgag agaatcaatc cgaattaatt 16800
tcggggaaaa agataaatta gatactaagc gatgggcttg ggctgggcta agaaacaggt 16860
ggcaattggg ctggaggacc ccgcgattca tagcttccga tagcccaaaa aaaaacggat 16920
aacatattta tcgggtattt gaatttcagt gaaataagat attttctttt tgttaggaaa 16980
attttagaaa ataatggaaa ttaaatagcg attatgttac aagatacgat cagcatcggg 17040
cagtgcaaaa tgctatagct tcccaagatt tgatcctttt gggttatctc ctaatgacaa 17100
ttagtttagg attttgaaac ttatattaat actattatcc gacaacactt gtttcagctt 17160
cttattttaa catttttgt tttttctat tcttcttccc atcagcattt tctttttaaa 17220
aaattgaata ctttaacttt ttaaaaattt cacaatgatc agatgatatt atggaagatc 17280
tcaagagtta aatgtatcca tcttggggca ttaaaaccgg tgtacgggat gataaataca 17340
gactttatat catatgatag ctcagtaatt catatttatc acgttgctaa aaaaattata 17400
aggtactagt agtcaacaaa atcaattaaa gagaaagaaa gaaacgcatg tgaagagagt 17460
ttacaactgg aaaagtaaaa taaaaattaa cgcatgttga atgctgacat gtcagtatgt 17520

ccatgaatcc acgtatcaag cgccattcat cgatcgtctt cctctttcta aatgaaaaca 17580
acttcacaca tcacaacaaa caatacacac aagaccccct ctctctcgtt gtctctctgc 17640
cagcgaccaa atcgaagctt gagaagaaca agaaggggtc aaaccatggc ttctacatct 17700
gctgctcaag acgctgctcc ttacgagttc ccttctctca ctgagatcaa gagggctctt 17760
ccttctgagt gtttcgaggc ttctgttcct ctttctctct actacaccgc tagatctctt 17820
gctcttgctg gatctctcgc tgttgctctc tcttacgcta gagctttgcc tcttgttcag 17880
gctaacgctc ttcttgatgc tactctctgc actggatacg ttcttctcca gggaatcgtt 17940
ttctggggat tcttcaccgt tggtcacgat tgtggacacg gagctttctc tagatctcac 18000
gtgctcaact tctctgttgg aaccctcatg cactctatca tccttacccc tttcgagtct 18060
tggaagctct ctcacagaca ccaccacaag aacaccggaa acatcgataa ggacgagatc 18120
ttctaccctc aaagagaggc tgattctcac cctgtttcta gacaccttgt gatgtctctt 18180
ggatctgctt ggttcgctta ccttttcgct ggattccctc ctagaaccat gaaccacttc 18240
aacccttggg aggctatgta tgttagaaga gtggctgctg tgatcatctc tctcggagtt 18300
cttttcgctt tcgctggact ctactcttac ctcaccttcg ttcttggatt caccactatg 18360
gctatctact acttcggacc tctcttcatc ttcgctacca tgcttgttgt taccactttc 18420
ctccaccaca acgatgagga gacaccttgg tacgctgatt ctgagtggac ttacgtgaag 18480
ggaaacctct cttctgtgga cagatcttac ggtgctctca tcgacaacct tagccacaac 18540
atcggaactc accagatcca ccacctcttc cctatcatcc ctcactacaa gctcaacgat 18600
gctactgctg ctttcgctaa ggctttccct gagcttgtta ggaaaaacgc tgctcctatc 18660
atcccaactt tcttcaggat ggctgctatg tacgctaagt acggagttgt tgacactgat 18720
gctaagacct tcactctcaa ggaggctaag gctgctgcta agactaagtc atcttgatga 18780
ttaatgaata attgattgta catactatat tttttgttta ccttgtgtta gtttaatgtt 18840
cagtgtcctc tctttattgt ggcacgtctc tttgttgtat gttgtgtcta tacaaagttg 18900
aaataatgga aagaaaagga agagtgtaat ttgttttgtt ttaagtgttt ataaatatat 18960
atatataggt catttagata gttctaggtt tctataaaac tctctctctg gaagtagaat 19020
ctgtttttga gaggatccag ttgcctacta atctccccca aaacccttca agcttaacct 19080
tcctcttcac aacaacagag gaaacacatc tcttgagctc tgagttctct tctttgagca 19140
tgtctatcgc taaactcatc tgccttatag cttccctctt ctcttcatct ctctctctca 19200
ccatttcgct gtaaaactta ttctcctccc tcagcctctc tatctcttcc ttcagcatct 19260
cacaattccc accataatcg actgaggatg attcaccgtc atcaacttca gactcagcgt 19320
tgtagtcgtc atgagtctca caagccttgg accaagaaga ctcatcatcg caagttgatg 19380
atttatcatg atgcttctct gagccgtgtt tgctacgtag cgtcacgtga cgttacctaa 19440
gcctaggtag cctcagctga cgttacgtaa cgctaggtag gctcagctga ctgcagcaaa 19500
tttacacatt gccactaaac gtctaaaccc ttgtaatttg tttttgtttt actatgtgtg 19560
ttatgtattt gatttgcgat aaatttttat atttggtact aaatttataa caccttttat 19620
gctaacgttt gccaacactt agcaatttgc aagttgatta attgattcta aattattttt 19680
gtcttctaaa tacatatact aatcaactgg aaatgtaaat atttgctaat atttctacta 19740
taggagaatt aaagtgagtg aatatggtac cacaaggttt ggagatttaa ttgttgcaat 19800
gctgcatgga tggcatatac accaaacatt caataattct tgaggataat aatggtacca 19860
cacaagattt gaggtgcatg aacgtcacgt ggacaaaagg tttagtaatt tttcaagaca 19920
acaatgttac cacacacaag ttttgaggtg catgcatgga tgccctgtgg aaagtttaaa 19980
aatattttgg aaatgatttg catggaagcc atgtgtaaaa ccatgacatc cacttggagg 20040
atgcaataat gaagaaaact acaaatttac atgcaactag ttatgcatgt agtctatata 20100
atgaggattt tgcaatactt tcattcatac acactcacta agttttacac gattataatt 20160
tcttcatagc cagtactgtt taagcttcac tgtctctgaa tcggcaaagg taaacgtatc 20220
aattattcta caaacccttt tatttttctt ttgaattacc gtcttcattg gttatatgat 20280
aacttgataa gtaaagcttc aataattgaa tttgatctgt gtttttttgg ccttaatact 20340
aaatccttac ataagctttg ttgcttctcc tcttgtgagt tgagtgttaa gttgtaataa 20400
tggttcactt tcagctttag aagaaacgcg ccttccatgg ctacaaagga ggcttacgtt 20460
ttcccaactc tcaccgagat caagagatct ctcccaaagg attgcttcga ggcttctgtg 20520
cctttgtctc tctactacac tgtgagatgc ttggttattg ctgtggcttt gaccttcgga 20580
ttgaactacg ctagagcttt gccagaggtt gagtctttct gggctttgga tgctgctttg 20640
tgcactggat atatcctcct ccagggaatt gtgttctggg gattcttcac tgttggacac 20700
gatgctggac acggagcttt ctctagatac cacctcttga acttcgttgt gggaaccttc 20760
atgcactctc tcatcttgac cccattcgag tcttggaagt tgacccacag acaccaccac 20820
aagaacaccg gaaacatcga tagagatgag gtgttctacc cacagagaaa ggctgatgat 20880
cacccattgt ccaggaactt gatcttggct ttgggagctg cttggcttgc ttatttggtg 20940
gagggattcc caccaagaaa ggtgaaccac ttcaacccat tcgagccact tttgtgaga 21000
caagtgtccg ctgtggttat ctctttgctc gctcacttct tcgttgctgg actctctatc 21060
tacttgtctc tccagttggg acttaagacc atggctatct actactacgg accagttttc 21120
gtgttcggat ctatgttggt gattaccacc ttcttgcacc acaacgatga ggagactcca 21180
tggtatgctg attctgagtg gacttacgtg aagggaaact tgtcctctgt ggatagatct 21240
tacggtgctc tcatcgataa cctctcccac aacatcggaa ctcaccagat ccaccacctc 21300
ttcccaatta tcccacacta caagctcaag aaggctactg ctgctttcca ccaagctttc 21360
ccagagcttg tgagaaagtc cgatgagcca atcatcaagg ctttcttcag agtgggaagg 21420
ttgtatgcta actacggagt ggttgatcaa gaggctaagc tcttcacttt gaaggaggct 21480
aaggctgcta ctgaagctgc tgctaagacc aagtctacct gattaatgaa tcgacaagct 21540
cgagtttctc cataataatg tgtgagtagt tcccagataa gggaattagg gttcctatag 21600

ggtttcgctc atgtgttgag catataagaa acccttagta tgtatttgta tttgtaaaat 21660
acttctatca ataaaatttc taattcctaa aaccaaaatc cagtactaaa atccagatcc 21720
cccgaattaa ttcggcgtta attcagctac gtaggctcag ctgagcttac ctaaggctac 21780
gtaggctcac gtgacgttac gtaaggctac gtagcgtcac gtgagcttac ctaactctag 21840
ctagcctcac gtgaccttag ctaacactag gtagcgtcag cacagatgaa tactagctgt 21900
tgttcacagt tctagtgtct cctcattacg tgaattcaag ctacgatcac tatctcaact 21960
cctacataaa catcagaatg ctacaaaact atgcacaaaa acaaaagcta catctaatac 22020
gtgaatcaat tactctcatc acaagaaaga agatttcaat caccgtcgag aaggaggatt 22080
cagttaattg aatcaaagtt ccgatcaaac tcgaagactg gtgagcacga ggacgacgaa 22140
gaagagtgtc tcgaagatac aacaagcaag aaatctactg agtgacctcc tgaagttatt 22200
ggcgcgattg agagaatcaa tccgaattaa tttcggggaa aaagataaat tagatactaa 22260
gcgatgggct tgggctgggc taagaaacag gtggcaattg ggctggagga ccccgcgatt 22320
catagcttcc gatagcccaa aaaaaaacgg ataacatatt tatcgggtat ttgaatttca 22380
gtgaaataag atattttctt tttgttagga aaattttaga aaataatgga aattaaatag 22440
cgattatgtt acaagatacg atcagcatcg ggcagtgcaa aatgctatag cttcccaaga 22500
tttgatcctt ttgggttatc tcctaatgac aattagttta ggattttgaa acttatatta 22560
atactattat ccgacaacac ttgtttcagc ttcttatttt aacatttttt gttttttct 22620
attcttcttc ccatcagcat tttcttttta aaaaattgaa tactttaact ttttaaaaat 22680
ttcacaatga tcagatgata ttatggaaga tctcaagagt taaatgtatc catcttgggg 22740
cattaaaacc ggtgtacggg atgataaata cagactttat atcatatgat agctcagtaa 22800
ttcatattta tcacgttgct aaaaaaatta taaggtacta gtagtcaaca aaatcaatta 22860
aagagaaaga aagaaacgca tgtgaagaga gtttacaact ggaaaagtaa aataaaaatt 22920
aacgcatgtt gaatgctgac atgtcagtat gtccatgaat ccacgtatca agcgccattc 22980
atcgatcgtc ttcctctttc taaatgaaaa caacttcaca catcacaaca aacaatacac 23040
acaagacccc ctctctctcg ttgtctctct gccagcgacc aaatcgaagc ttgagaagaa 23100
caagaagggg tcaaaccatg ggaaaaggat ctgagggaag atctgctgct agagagatga 23160
ctgctgaggc taacggagat aagagaaaga ccatcctcat tgagggagtg ttgtacgatg 23220
ctaccaactt caaacaccca ggaggttcca ttattaactt cctcaccgag ggagaagctg 23280
gagttgatgc tacccaagct tacagagagt tccatcagag atccggaaag gctgataagt 23340
acctcaagtc cctcccaaag ttggatgctt ctaaggtgga gtctaggttc tctgctaagg 23400
agcaggctag aagggacgct atgaccaggg attacgctgc tttcagagag gagttggttg 23460
ctgagggata cttcgatcca tctatcccac acatgatcta cagagtggtg gagattgtgg 23520
ctttgttcgc tttgtctttc tggttgatgt ctaaggcttc tccaacctct ttggttttgg 23580
gagtggtgat gaacggaatc gctcaaggaa gatgcggatg ggttatgcac gagatgggac 23640
acggatcttt cactggagtt atctggctcg atgataggat gtgcgagttc ttctacggag 23700
ttggatgtgg aatgtctgga cactactgga agaaccagca ctctaagcac cacgctgctc 23760
caaacagatt ggagcacgat gtggatttga acaccttgcc actcgttgct ttcaacgaga 23820
gagttgtgag gaaggttaag ccaggatctt tgttggcttt gtggctcaga gttcaggctt 23880
atttgttcgc tccagtgtct tgcttgttga tcggattggg atggaccttg tacttgcacc 23940
caagatatat gctcaggacc aagagacaca tggagtttgt gtggatcttc gctagatata 24000
tcggatggtt ctccttgatg ggagctttgg gatattctcc tggaacttct gtgggaatgt 24060
acctctgctc tttcggactt ggatgcatct acatcttcct ccaattcgct gtgtctcaca 24120
cccacttgcc agttaccaac ccagaggatc aattgcactg gcttgagtac gctgctgatc 24180
acaccgtgaa catctctacc aagtcttggt tggttacctg gtggatgtct aacctcaact 24240
tccaaatcga gcaccacttg ttcccaaccg ctccacaatt caggttcaag gagatctctc 24300
caagagttga ggctctcttc aagagacaca acctcccctta ctacgatttg ccatacacct 24360
ctgctgtttc tactaccttc gctaacctct actctgttgg acactctgtt ggagctgata 24420
ccaagaagca ggattgatga ttaatgaata attgattgta catactatat tttttgttta 24480
ccttgtgtta gtttaatgtt cagtgtcctc tctttattgt ggcacgtctc tttgttgtat 24540
gttgtgtcta tacaaagttg aaataatgga aagaaaagga agagtgtaat ttgttttgtt 24600
ttaagtgttt ataaatatat atatataggt catttagata gttctaggtt tctataaaac 24660
tctctctctg gaagtagaat ctgtttttga gaggatccag ttgcctacta atctccccca 24720
aaacccttca agcttaacct tcctcttcac aacaacagag gaaacacatc tcttgagctc 24780
tgagttctct tctttgagca tgtctatcgc taaactcatc tgccttatag cttccctctt 24840
ctcttcatct ctctctctca ccatttcgct gtaaaactta ttctcctccc tcagcctctc 24900
tatctcttcc ttcagcatct cacaattccc accataatcg actgaggatg attcaccgtc 24960
atcaacttca gactcagcgt tgtagtcgtc atgagtctca caagccttgg accaagaaga 25020
ctcatcatcg caagttgatg atttatcatg atgcttctct gagccgtgtt tgctacctag 25080
agtcagctga gcttagctaa cgctagctag tgtcagctga cgttacgtaa ggctaactag 25140
cgtcacgtga ccttacgtaa cgctacgtag gctcagctga gcttagctaa ccctagctag 25200
tgtcacgtga gcttacgcta ctatagaaaa tgtgttatat cgacatgacc agacaaaggg 25260
gcaacagtta acaaaacaat taattctttc atttgagatt aaggaaggta aggtactaaa 25320
aagattaaaa aaaatgagct tatctctttg tttctgtaat aataatataa gtgtgataaa 25380
cttttaatat aataattgta attaggtttt ctacagatga gcaccactca gagacaagat 25440
aagaagaaaa caattttgtt aaacatgatt atagaaactt ttagttaagt cttgaagtat 25500
caatataaca aaaaaaagta cacacgacta tgacaataaa cccactaccg tcaggttatc 25560
atttcgatga aatgttttga tatcattaaa tataacagtc acaaaaaatc atctaattat 25620
aacaatataa cttatacata tatttaacta aaaacttaga gtttttgtaa tgattctaat 25680

```
tgatgattag agtttataga aatacaatta aataaaaaat ataattttaa aaaaacatag  25740
taaagtcaat gagatcctct ctgacctcag tgatcattta gtcatgtatg tacaacaatc  25800
attgttcatc acatgactgt aaaataaata aggataaact tgggaatata tataatatat  25860
tgtattaaat aaaaaaggga aatacaaata tcaattttag attcccgagt tgacacaact  25920
caccatgcac gctgccacct cagctcccag ctctcgtcac atgtctcatg tcagttaggt  25980
ctttggtttt tagtctttga cacaactcgc catgcatgtt gccacgtgag ctcgttcctc  26040
ttcccatgat ctcaccactg ggcatgcatg ctgccacctc agctggcacc tcttctctat  26100
atgtccctag aggccatgca cagtgccacc tcagcactcc tctcagaacc catacgtacc  26160
tgccaatcgg cttctctcca taaatatcta tttaaattat aactaattat ttcatatact  26220
taattgatga cgtggatgca ttgccatcgt tgtttaataa ttgttaatta cgacatgata  26280
aataaaatga aagtaaaaag tacgaaagat tttccatttg ttgttgtata aatagagaag  26340
tgagtgatgc ataatgcatg aatgcatgac cgcgccacca tgactgttgg atacgacgag  26400
gagatcccat tcgagcaagt tagggctcat aacaagccag acgacgcttg gtgtgctatt  26460
cacggacacg tgtacgacgt taccaagttc gcttcagttc acccaggagg agatattatc  26520
ttgctcgctg ctggaaagga agctactgtc ctctacgaga cctaccatgt tagaggagtg  26580
tctgacgctg tgctcagaaa gtacagaata ggaaagttgc cagacggaca aggaggagct  26640
aacgagaagg agaagagaac cttgtctgga ttgtcctctg cttcttacta cacctggaac  26700
tccgatttct acagagtgat gagggagaga gttgtggcta gattgaagga gagaggaaag  26760
gctagaagag gaggatacga actctggatc aaggctttct tgctccttgt tggattctgg  26820
tcctctcttt actggatgtg caccctcgat ccatctttcg gagctatctt ggctgctatg  26880
tctttgggag tgttcgctgc ttttgttgga acctgcatcc aacacgatgg aaaccacgga  26940
gctttcgctc aatctagatg ggttaacaag gtggcaggat ggactttgga tatgatcgga  27000
gcttctggaa tgacttggga gttccaacac gtgttgggac accacccata cactaacttg  27060
atcgaggagg agaacggatt gcaaaaggtg tccggaaaga agatggatac caagttggct  27120
gatcaagagt ctgatccaga tgtgttctcc acctacccaa tgatgagatt gcacccttgg  27180
caccagaaga ggtggtatca caggttccag cacatctacg gacctttcat cttcggattc  27240
atgaccatca acaaggtggt gactcaagat gttggagtgg tgttgagaaa gagactcttc  27300
caaatcgatg ctgagtgcag atatgcttcc ccaatgtacg ttgctaggtt ctggattatg  27360
aaggctttga ccgtgttgta tatggttgct ttgccttgtt atatgcaagg accttggcac  27420
ggattgaaac tcttcgctat cgctcacttc acttgcggag aggttttggc taccatgttc  27480
atcgtgaacc acattatcga gggagtgtct tacgcttcta aggatgctgt taagggaact  27540
atggctccac caaagactat gcacggagtg accccaatga acaacactag aaaggaggtt  27600
gaggctgagg cttctaagtc tggagctgtg gttaagtctg tgccattgga tgattgggct  27660
gctgttcagt gccaaacctc tgtgaactgg tctgttggat cttggttttg gaaccacttc  27720
tctggaggac tcaaccacca aatcgagcac cacctcttcc caggattgtc tcacgagacc  27780
tactaccaca tccaagacgt ggttcaatct acctgtgctg agtacggagt tccataccaa  27840
cacgagccat ctttgtggac tgcttactgg aagatgctcg aacaccttag acaattggga  27900
aacgaggaga ctcacgagtc atggcagaga gctgcttgat taatgaacta agactcccaa  27960
aaccaccttc cctgtgacag ttaaaccctg cttatacctt tcctcctaat aatgttcatc  28020
tgtcacacaa actaaaataa ataaaatggg agcaataaat aaaatgggag ctcatatatt  28080
tacaccattt acactgtcta ttattcacca tgccaattat tacttcataa ttttaaaatt  28140
atgtcatttt taaaaattgc ttaatgatgg aaaggattat tataagttaa aagtataaca  28200
tagataaact aaccacaaaa caaatcaata taaactaact tactctccca tctaattttt  28260
atttaaattt ctttacactt ctcttccatt tctatttcta caacattatt taacattttt  28320
attgtatttt tcttactttc taactctatt catttcaaaa atcaatatat gtttatcacc  28380
acctctctaa aaaaaacttt acaatcattg gtccagaaaa gttaaatcac gagatggtca  28440
ttttagcatt aaaacaacga ttcttgtatc actatttttc agcatgtagt ccattctctt  28500
caaacaaaga cagcggctat ataatcgttg tgttatattc agtctaaaac aactagctag  28560
cctcagctga cgttacgtaa cgctaggtag cgtcacgtga cgttagctaa cgctaggtag  28620
cgtcagctga gcttacgtaa gcgccacggg caggacatag ggactactac aagcatagta  28680
tgcttcagac aaagagctag gaaagaactc ttgatggagg ttaagagaaa aaagtgctag  28740
aggggcatag taatcaaact tgtcaaaacc gtcatcatga tgagggatga cataatataa  28800
aaagttgact aaggtcttgg tagtactctt tgattagtat tatatattgg tgagaacatg  28860
agtcaagagg agacaagaaa ccgaggaacc atagtttagc aacaagatgg aagttgcaaa  28920
gttgagctag ccgctcgatt agttacatct cctaagcagt actacaagga atggtctcta  28980
tactttcatg tttagcacat ggtagtgcgg attgacaagt tagaaacagt gcttaggaga  29040
caaagagtca gtaaaggtat tgaaagagtg aagttgatgc tcgacaggtc aggagaagtc  29100
cctccgccag atggtgacta ccaaggggtt ggtatcagct gagacccaaa taagattctt  29160
cggttgaacc agtggttcga ccgagactct tagggtggga tttcactgta agatttgtgc  29220
attttgttga atataaattg acaatttttt ttatttaatt atagattatt tagaatgaat  29280
tacatattta gtttctaaca aggatagcaa tggatgggta tgggtacagg ttaaacatat  29340
ctattaccca cccatctagt cgtcgggttt tacacgtacc cacccgttta cataaaccag  29400
aacggaattt taaaccgtac ccgtccgtta gcgggtttca gatttacccg tttaatcggg  29460
taaaacctga ttactaaata tatatttttt atttgataaa caaaacaaaa atgttaatat  29520
tttcatattg gatgcaattt taagaaacac atattcataa atttccatat ttgtaggaaa  29580
ataaaaagaa aaatatattc aagaacacaa atttcaccga catgactttt attacagagt  29640
tggaattaga tctaacaatt gaaaaattaa aattaagata gaatatgttg aggaacatga  29700
catagtataa tgctgggtta cccgtcgggt aggtatcgag gcggatacta ctaaatccat  29760
```

cccactcgct atccgataat cactggtttc gggtataccc attcccgtca acaggccttt 29820
ttaaccggat aatttcaact tatagtgaat gaattttgaa taaatagtta gaataccaaa 29880
atcctggatt gcatttgcaa tcaaattttg tgaaccgtta aattttgcat gtacttggga 29940
tagatataat agaaccgaat tttcattagt ttaatttata acttactttg ttcaaagaaa 30000
aaaaatatct atccaattta cttataataa aaaataatct atccaagtta cttattataa 30060
tcaacttgta aaaaggtaag aatacaaatg tggtagcgta cgtgtgatta tatgtgacga 30120
aatgttatat ctaacaaaag tccaaattcc catggtaaaa aaaatcaaaa tgcatggcag 30180
gctgtttgta accttggaat aagatgttgg ccaattctgg agccgccacg tacgcaagac 30240
tcagggccac gttctcttca tgcaaggata gtagaacacc actccaccca cctcctatat 30300
tagacctttg cccaacccctc cccaactttc ccatcccatc cacaaagaaa ccgacatttt 30360
tatcataaat cagggtttcg tttttgtttc atcgataaac tcaaaggtga tgattttagg 30420
gtcttgtgag tgtgcttttt tgtttgattc tactgtaggg tttatgttct ttagctcata 30480
ggttttgtgt atttcttaga aatgtggctt ctttaatctc tgggtttgtg actttttgtg 30540
tggtttctgt gtttttcata tcaaaaacct attttttccg agttttttttt tacaaattct 30600
tactctcaag cttgaatact tcacatgcag tgttcttttg tagattttag agttaatgtg 30660
ttaaaaagtt tggattttc ttgcttatag agcttcttca ctttgatttt gtgggttttt 30720
ttgttttaaa ggtgagattt ttgatgaggt ttttgcttca aagatgtcac ctttctgggt 30780
ttgtcttttg aataaagcta tgaactgtca catggctgac gcaattttgt tactatgtca 30840
tgaaagctga cgtttttccg tgttatacat gtttgcttac acttgcatgc gtcaaaaaaa 30900
ttggggcttt ttagttttag tcaaagattt tacttctctt ttgggattta tgaaggaaag 30960
ttgcaaactt tctcaaattt taccattttt gctttgatgt ttgtttagat tgcgacagaa 31020
caaactcata tatgttgaaa tttttgcttg gttttgtata ggattgtgtc ttttgcttat 31080
aaatgttgaa atctgaactt tttttttgtt tggtttcttt gagcaggaga taaggcgcac 31140
caccatggct tctacatctg ctgctcaaga cgctgctcct tacgagttcc cttctctcac 31200
tgagatcaag agggctcttc cttctgagtg tttcgaggct tctgttcctc tttctctcta 31260
ctacaccgct agatctcttg ctcttgctgg atctctcgct gttgctctct cttacgctag 31320
agctttgcct cttgttcagg ctaacgctct tcttgatgct actctctgca ctggatacgt 31380
tcttctccag ggaatcgttt tctggggatt cttcaccgtt ggtcacgatt gtggacacgg 31440
agctttctct agatctcacg tgctcaactt ctctgttgga accctcatgc actctatcat 31500
ccttacccct ttcgagtctt ggaagctctc tcacagacac caccacaaga acaccggaaa 31560
catcgataag gacgagatct tctaccctca aagagaggct gattctcacc ctgtttctag 31620
acaccttgtg atgtctcttg gatctgcttg gttcgcttac cttttcgctg gattccctcc 31680
tagaaccatg aaccacttca acccttggga ggctatgtat gttagaagag tggctgctgt 31740
gatcatctct ctcggagttc ttttcgcttt cgctggactc tactcttacc tcaccttcgt 31800
tcttggattc accactatgg ctatctacta cttcggacct ctcttcatct tcgctaccat 31860
gcttgttgtt accactttcc tccaccacaa cgatgaggag acaccttggt acgctgattc 31920
tgagtggact tacgtgaagg gaaacctctc ttctgtggac agatcttacg gtgctctcat 31980
cgacaacctt agccacaaca tcggaactca ccagatccac cacctcttcc ctatcatccc 32040
tcactacaag ctcaacgatg ctactgctgc tttcgctaag gctttccctg agcttgttag 32100
gaaaaacgct gctcctatca tcccaacttt cttcaggatg gctgctatgt acgctaagta 32160
cggagttgtt gacactgatg ctaagacctt cactctcaag gaggctaagg ctgctgctaa 32220
gactaagtca tcttgatgat taatgaaggc cgcagatatc agatctggtc gacctagagg 32280
atccccggcc gcaaagataa taacaaaagc ctactatata acgtacatgc aagtattgta 32340
tgatattaat gtttttacgt acgtgtaaac aaaaataatt acgtttgtaa cgtatggtga 32400
tgatgtggtg cactaggtgt aggccttgta ttaataaaaa gaagtttgtt ctatatagag 32460
tggtttagta cgacgattta tttactagtc ggattggaat agagaaccga attcttcaat 32520
ccttgctttt gatcaagaat tgaaaccgaa tcaaatgtaa aagttgatat atttgaaaaa 32580
cgtattgagc ttatgaaaat gctaatactc tcatctgtat ggaaaagtga ctttaaaacc 32640
gaacttaaaa gtgacaaaag gggaatatcg catcaaaccg aatgaaaccg atctacgtag 32700
gctcagctga gcttacctaa ggctacgtag gctcacgtga cgttacgtaa ggctacgtag 32760
cgtcacgtga gcttacctaa ctctagctag cctcacgtga ccttagctaa cactaggtag 32820
cgtcagctta gcagatattt ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa 32880
atggtggttt cgaaaccagg gacaacgttg ggatctgata gggtgtcaaa gagtattatg 32940
gattgggaca atttcggtca tgagttgcaa attcaagtat atcgttcgat tatgaaaatt 33000
ttcgaagaat atcccatttg agagagtctt tacctcatta atgtttttag attatgaaat 33060
tttatcatag ttcatcgtag tctttttggt gtaaaggctg taaaaagaaa ttgttcactt 33120
ttgttttcgt ttatgtgaag gctgtaaaag attgtaaaag actattttgg tgttttggat 33180
aaaatgatag tttttataga ttcttttgct tttagaagaa atacatttga aattttttcc 33240
atgttgagta taaaataccg aaatcgattg aagatcatag aaatatttta actgaaaaca 33300
aatttataac tgattcaatt ctctccattt ttatacctat ttaaccgtaa tcgattctaa 33360
tagatgatcg attttttata taatcctaat taaccaacgg catgtattgg ataattaacc 33420
gatcaactct cacccctaat agaatcagta ttttccttcg acgttaattg atcctacact 33480
atgtaggtca tatccatcgt tttaattttt ggccaccatt caattctgtc ttgcctttag 33540
ggatgtgaat atgaacggcc aaggtaagag aataaaaata atccaaatta aagcaagaga 33600
ggccaagtaa gataatccaa atgtacactt gtcattgcca aaattagtaa aatactcggc 33660
atattgtatt cccacacatt attaaaatac cgtatatgta ttggctgcat ttgcatgaat 33720
aatactacgt gtaagcccaa aagaacccac gtgtagccca tgcaaagtta acactcacga 33780
ccccattcct cagtctccac tatataaacc caccatcccc aatctcacca aacccaccac 33840

acaactcaca actcactctc acaccttaaa gaaccaatca ccaccaaaaa aagttctttg 33900
ctttcgaagt tgccgcaacc taaacaggtt tttccttctt ctttcttctt attaactacg 33960
accttgtcct ttgcctatgt aaaattacta ggttttcatc agttacactg attaagttcg 34020
ttatagtgga agataaaatg ccctcaaagc attttgcagg atatctttga tttttcaaag 34080
atatggaact gtagagtttg atagtgttct tgaatgtggt tgcatgaagt ttttttggtc 34140
tgcatgttat tttttcctcg aaatatgttt tgagtccaac aagtgattca cttgggattc 34200
agaaagttgt tttctcaata tgtaacagtt tttttctatg gagaaaaatc atagggaccg 34260
ttggttttgg cttctttaat tttgagctca gattaaaccc attttacccg gtgttcttgg 34320
cagaattgaa aacagtacgt agtaccgcgc ctaccatgcc acctagtgct gctagtgaag 34380
gtggtgttgc tgaacttaga gctgctgaag ttgctagcta cactagaaag gctgttgacg 34440
aaagacctga cctcactata gttggtgacg ctgtttacga cgctaaggct tttagggacg 34500
agcaccctgg tggtgctcac ttcgttagcc ttttcggagg tagggacgct actgaggctt 34560
ttatggaata tcaccgtaga gcttggccta aggctaggat gtctaagttc ttcgttggtt 34620
cacttgacgc tagcgagaag cctactcaag ctgattcagc ttaccttaga ctttgcgctg 34680
aggttaacgc tcttttgcct aagggtagcg gaggattcgc tcctcctagc tactggctta 34740
aggctgctgc tcttgttgtt gctgctgtta gtatagaggg ttatatgctc cttaggggta 34800
agaccctttt gcttagcgtt ttccttggac tcgtgttcgc ttggatagga cttaatattc 34860
agcacgacgc taatcacggt gctcttagta gacactcagt gattaactac tgcctcggtt 34920
acgctcagga ttggataggt ggtaatatgg tgctttggct tcaagagcac gttgtgatgc 34980
accacctcca cactaacgac gttgacgctg atcctgatca aaaggctcac ggtgttctta 35040
gacttaagcc tactgacggt tggatgcctt ggcacgcact tcaacaactc tatatccttc 35100
ctggtgaggc tatgtacgct tttaagcttc ttttcttgga cgcccttgag cttcttgctt 35160
ggaggtggga gggtgagaag attagccctc ttgctagagc tttgttcgct cctgctgttg 35220
cttgtaagct tggattctgg gctagattcg ttgctctccc tctctggctt caacctactg 35280
ttcacactgc tttgtgtatc tgtgctactg tgtgtactgg tagcttctac ctcgccttct 35340
tcttctttat ctctcacaac ttcgacggtg ttggtagcgt tggacctaag ggatcacttc 35400
ctagatcagc tactttcgtt caacgtcagg ttgagactag ctctaacgtt ggtggttact 35460
ggcttggagt tcttaacggt ggacttaact ttcagataga gcaccacttg ttccctaggc 35520
ttcaccactc ttactacgct caaatagctc ctgtggttag gactcacata gagaagctcg 35580
gttttaagta ccgtcacttc cctaccgttg gatctaacct tagctcaatg cttcagcata 35640
tgggtaagat gggaactaga cctggtgctg agaagggtgg taaggctgag tagtgattaa 35700
tgaataattg attgctgctt taatgagata tgcgagacgc ctatgatcgc atgatatttg 35760
ctttcaattc tgttgtgcac gttgtaaaaa acctgagcat gtgtagctca gatccttacc 35820
gccggtttcg gttcattcta atgaatatat cacccgttac tatcgtattt ttatgaataa 35880
tattctccgt tcaatttact gattgtctac gtagcgtcac ctgacgttac gtaaggctac 35940
ctaggctcac gtgacgttac gtaacgctac gtagcgtcag gtgaggttag ctaacgctag 36000
ctagcctcac ctgacgttag gtaaggctac gtagcgtcac ctgagattag ctaagcctac 36060
ctagactcac gtgaccttag gtaacgctac gtagcgtcaa agctttacaa cgctacacaa 36120
aacttataac cgtaatcacc attcattaac ttaactacta tcacatgcat tcatgaattg 36180
aaacgagaag gatgtaaata gttgggaagt tatctccacg ttgaagagat cgttagcgag 36240
agctgaaaga ccgagggagg agacgccgtc aacacggaca gagtcgtcga ccctcacatg 36300
aagtaggagg aatctccgtg aggagccaga gagacgtctt tggtcttcgg tttcgatcct 36360
tgatctgacg gagaagacga gagaagtgcg actggactcc gtgaggacca acagagtcgt 36420
cctcggtttc gatcgtcggt attggtggag aaggcggagg aatctccgtg acgagccaga 36480
gagatgtcgt cggtcttcgg tttcgatcct tgatctgacg gagaagacga gagaagtgcg 36540
acgagactcc gtgaggacca acagagttgt cctcggtttc gatcgtcggt ttcggcggag 36600
aaggcggagg aatctccgtg aggagccaga gagacgtcgt tggtcttcgg tttcgatcct 36660
tgatctgttg gagaagacga gacaagtggg acgagactca acgacggagt cagagacgtc 36720
gtcggtcttc ggtttcggcc gagaaggcgg agtcggtctt cggtttcggc cgagaaggcg 36780
gaggagacgt cttcgatttg ggtctctcct cttgacgaag aaaacaaaga acacgagaaa 36840
taatgagaaa gagaacaaaa gaaaaaaaaa taaaaataaa aataaaattt ggtcctctta 36900
tgtggtgaca cgtggtttga aacccaccaa ataatcgatc acaaaaaacc taagttaagg 36960
atcggtaata acctttctaa ttaattttga tttatattaa atcactcttt ttatttataa 37020
accccactaa attatgcgat attgattgtc taagtacaaa aattctctcg aattcaatac 37080
acatgtttca tatatttagc cctgttcatt taatattact agcgcatttt taatttaaaa 37140
ttttgtaaac ttttttggtc aaagaacatt tttttaatta gagacagaaa tctagactct 37200
ttatttggaa taatagtaat aaagatatat taggcaatga gtttatgatg ttatgtttat 37260
atagtttatt tcattttaaa ttgaaaagca ttattttat cgaaatgaat ctagtataca 37320
atcaatattt atgtttttc atcagatact ttcctatttt ttggcacctt tcatcggact 37380
actgatttat ttcaatgtgt atgcatgcat gagcatgagt atacacatgt cttttaaaat 37440
gcatgtaaag cgtaacggac cacaaaagag gatccataca aatacatctc atcgcttcct 37500
ctactattct ccgacacaca cactgagcat ggtgcttaaa cactctggtg agttctagta 37560
cttctgctat gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt 37620
tcttgatttt tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt 37680
ttttttgtg gttaatttag tttcctatgt tcttcgattg tattatgcat gatctgtgtt 37740
tggattctgt tagattatgt attggtgaat atgtatgtgt ttttgcatgt ctggttttgg 37800
tcttaaaaat gttcaaatct gatgatttga ttgaagcttt tttagtgttg gtttgattct 37860
tctcaaaact actgttaatt tactatcatg ttttccaact ttgattcatg atgacacttt 37920

tgttctgctt tgttataaaa ttttggttgg tttgatttg taattatagt gtaattttgt 37980
taggaatgaa catgttttaa tactctgttt tcgatttgtc acacattcga attattaatc 38040
gataatttaa ctgaaaattc atggttctag atcttgttgt catcagatta tttgtttcga 38100
taattcatca aatatgtagt ccttttgctg atttgcgact gtttcatttt ttctcaaaat 38160
tgttttttgt taagtttatc taacagttat cgttgtcaaa agtctctttc attttgcaaa 38220
atcttctttt tttttttgtt tgtaactttg ttttttaagc tacacattta gtctgtaaaa 38280
tagcatcgag gaacagttgt cttagtagac ttgcatgttc ttgtaacttc tatttgtttc 38340
agtttgttga tgactgcttt gattttgtag gtcaaaccgc gccatgtctg ctagcggagc 38400
tttgttgcct gctatagctt tcgctgctta cgcttacgct acctacgctt atgctttcga 38460
gtggagccac gctaacggaa tcgataacgt ggatgctaga gagtggattg gagctttgtc 38520
tttgagactc cctgcaattg caaccacaat gtacctcttg ttctgccttg tgggacctag 38580
attgatggct aagagggagg cttttgatcc taagggattt atgctcgctt acaacgctta 38640
ccaaaccgct ttcaacgttg tggtgctcgg aatgttcgct agagagatct ctggattggg 38700
acaacctgtt tggggatcta ctatgccttg gagcgatagg aagtccttca agattttgtt 38760
gggagtgtgg ctccactaca acaataagta cctcgagttg ttggatactg tgttcatggt 38820
ggctaggaaa aagaccaagc agctctcttt cttgcacgtg taccaccacg ctttgttgat 38880
ttgggcttgg tggcttgttt gtcacctcat ggctaccaac gattgcatcg atgcttattt 38940
cggagctgct tgcaactctt tcatccacat cgtgatgtac tcctactacc tcatgtctgc 39000
tttgggaatt aggtgccctt ggaagagata tatcacccag gctcagatgt tgcaattcgt 39060
gatcgtgttc gctcacgctg ttttcgtgct cagacaaaag cactgccctg ttactttgcc 39120
ttgggcacaa atgttcgtga tgacaaatat gttggtgctc ttcggaaact tctacctcaa 39180
ggcttactct aacaagtcta ggggagatgg agcttcttct gttaagcctg ctgagactac 39240
tagagcacct tctgtgagaa gaaccaggtc aaggaagatc gattgatagt taatgaacta 39300
agtttgatgt atctgagtgc caacgtttac tttgtctttc ctttctttta ttggttatga 39360
ttagatgttt actatgttct ctctttttcg ttataaataa agaagttcaa ttcttctata 39420
gtttcaaacg cgattttaag cgtttctatt taggtttaca tgatttcttt tacaaaatca 39480
tctttaaaat acagtatatt tttagttttc ataaaatatt taaagaaatg aaagtttata 39540
aacattcact cctattctct aattaaggat ttgtaaaaca aaaattttgt aagcatatcg 39600
atttatgcgt tttgtcttaa ttagctcact aaataataaa taatagctta tgttgtggga 39660
ctgtttaatt acctaactta gaactaaaat caactctttg tgctagctag cctcagctga 39720
cgttacgtaa cgctaggtag cgtcacgtga cgttagctaa cgctaggtag cgtcagctga 39780
gcttacgtaa gcgcttaatt aaagtactga tatcggtacc aaatcgaatc caaaaattac 39840
ggatatgaat ataggcatat ccgtatccga attatccgtt tgacagctag caacgattgt 39900
acaattgctt ctttaaaaaa ggaagaaaga aagaaagaaa agaatcaaca tcagcgttaa 39960
caaacggccc cgttacggcc caaacggtca tatagagtaa cggcgttaag cgttgaaaga 40020
ctcctatcga aatacgtaac cgcaaacgtg tcatagtcag atcccctctt ccttcaccgc 40080
ctcaaacaca aaaaataatct tctacagcct atatatacaa cccccccttc tatctctcct 40140
ttctcacaat tcatcatctt tctttctcta cccccaattt taagaaatcc tctcttctcc 40200
tcttcatttt caaggtaaat ctctctctct ctctctctct ctgttattcc ttgttttaat 40260
taggtatgta ttattgctag tttgttaatc tgcttatctt atgtatgcct tatgtgaata 40320
tctttatctt gttcatctca tccgtttaga agctataaat ttgttgattt gactgtgtat 40380
ctacacgtgg ttatgtttat atctaatcag atatgaattt cttcatattg ttgcgtttgt 40440
gtgtaccaat ccgaaatcgt tgattttttt catttaatcg tgtagctaat tgtacgtata 40500
catatggatc tacgtatcaa ttgttcatct gtttgtgttt gtatgtatac agatctgaaa 40560
acatcacttc tctcatctga ttgtgttgtt acatacatag atatagatct gttatatcat 40620
tttttttatt aattgtgtat atatatatgt gcatagatct ggattacatg attgtgatta 40680
tttacatgat tttgttattt acgtatgtat atatgtagat ctggactttt tggagttgtt 40740
gacttgattg tatttgtgtg tgtatatgtg tgttctgatc ttgatatgtt atgtatgtgc 40800
agctgaacca tggcggcggc aacaacaaca acaacaacat cttcttcgat ctccttctcc 40860
accaaaccat ctccttcctc ctccaaatca ccattaccaa tctccagatt ctccctccca 40920
ttctccctaa accccaacaa atcatcctcc tcctcccgcc gccgcggtat caaatccagc 40980
tctccctcct ccatctccgc cgtgctcaac acaaccacca atgtcacaac cactccctct 41040
ccaaccaaac ctaccaaacc cgaaacattc atctcccgat tcgctccaga tcaaccccgc 41100
aaaggcgctg atatcctcgt cgaggcttta gaacgtcaag gcgtagaaac cgtattcgct 41160
taccctggag gtacatcaat ggagattcac caagccttaa cccgctcttc ctcaatccgt 41220
aacgtccttc ctcgtcacga acaaggaggt gtattcgcag cagaaggata cgctcgatcc 41280
tcaggtaaac caggtatctg tatagccact tcaggtcccg gagctacaaa tctcgttagc 41340
ggattagccg atgcgttgtt agatagtgtt cctcttgtag caatcacagg acaagtccct 41400
cgtcgtatga ttggtacaga tgcgtttcaa gagactccga ttgttgaggt aacgcgttcg 41460
attacgaagc ataactatct tgtgatggat gttgaagata tcccaaggat tattgaagag 41520
gctttctttt tagctacttc tggtagacct ggacctgttt tggttgatgt tcctaaagat 41580
attcaacaac agcttgcgat tcctaattgg gaacaggcta tgagattacc tggttatatg 41640
tctaggatgc ctaaacctcc ggaagattct catttggagc agattgttag gttgatttct 41700
gagtctaaga agcctgtgtt gtatgttggt ggtggttgtc ttaattctag cgatgaattg 41760
ggtaggtttg ttgagcttac gggcatccct gttgcgagta cgttgatggg gctgggatct 41820
tatccttgtg atgatgagtt gtcgttacat atgcttggaa tgcatgggac tgtgtatgca 41880
aattacgctg tggagcatag tgatttgttg ttggcgtttg gggtaaggtt tgatgatcgt 41940
gtcacgggta aacttgaggc ttttgctagt agggctaaga ttgttcatat tgatattgac 42000

tcggctgaga ttgggaagaa taagactcct catgtgtctg tgtgtggtga tgttaagctg 42060
gctttgcaag ggatgaataa ggttcttgag aaccgagcgg aggagcttaa acttgatttt 42120
ggagtttgga ggaatgagtt gaacgtacag aaacagaagt ttccgttgag ctttaagacg 42180
tttggggaag ctattcctcc acagtatgcg attaaggtcc ttgatgagtt gactgatgga 42240
aaagccataa taagtactgg tgtcgggcaa catcaaatgt gggcggcgca gttctacaat 42300
tacaagaaac caaggcagtg gctatcatca ggaggccttg gagctatggg atttggactt 42360
cctgctgcga ttggagcgtc tgttgctaac cctgatgcga tagttgtgga tattgacgga 42420
gatggaagtt ttataatgaa tgtgcaagag ctagccacta ttcgtgtaga gaatcttcca 42480
gtgaaggtac ttttattaaa caaccagcat cttggcatgg ttatgcaatg ggaagatcgg 42540
ttctacaaag ctaaccgagc tcacacattt ctcggggacc cggctcagga ggacgagata 42600
ttcccgaaca tgttgctgtt tgcagcagct tgcgggattc cagcggcgag ggtgacaaag 42660
aaagcagatc tccgagaagc tattcagaca atgctggata caccaggacc ttacctgttg 42720
gatgtgattt gtccgcacca agaacatgtg ttgccgatga tcccgaatgg tggcactttc 42780
aacgatgtca taacggaagg agatggccgg attaaatact gagagatgaa accggtgatt 42840
atcagaacct tttatggtct ttgtatgcat atggtaaaaa aacttagttt gcaatttcct 42900
gtttgttttg gtaatttgag tttcttttag ttgttgatct gcctgctttt tggtttacgt 42960
cagactacta ctgctgttgt tgtttggttt cctttctttc attttataaa taaataatcc 43020
ggttcggttt actccttgtg actggctcag tttggttatt gcgaaatgcg aatggtaaat 43080
tgagtaattg aaattcgtta ttagggttct aagctgtttt aacagtcact gggttaatat 43140
ctctcgaatc ttgcatggaa aatgctctta ccattggttt ttaattgaaa tgtgctcata 43200
tgggccgtgg tttccaaatt aaataaaact acgatgtcat cgagaagtaa aatcaactgt 43260
gtccacatta tcagttttgt gtatacgatg aaatagggta attcaaaatc tagcttgata 43320
tgccttttgg ttcattttaa ccttctgtaa acatttttc agattttgaa caagtaaatc 43380
caaaaaaaaa aaaaaaaatc tcaactcaac actaaattat tttaatgtat aaaagatgct 43440
taaaacattt ggcttaaaag aaagaagcta aaaacataga gaactcttgt aaattgaagt 43500
atgaaaatat actgaattgg gtattatatg aatttttctg atttaggatt cacatgatcc 43560
aaaaaggaaa tccagaagca ctaatcagac attggaagta ggattaatca gtgatcagta 43620
actattaaat tcaattaacc gcggacatct acatttttga attgaaaaaa aattggtaat 43680
tactctttct ttttctccat attgaccatc atactcattg ctgatccatg tagatttccc 43740
ggacatgaag ccatata 43757

<210> 282
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 1 RB junction region

<400> 282
agctcgcaat ccagtcagca 20

<210> 283
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 1 LB junction region

<400> 283
aagccatata tctgacccta 20

<210> 284
<211> 1100
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 1 flanking sequence up to and including the right border of the T-DNA

<400> 284
tatttttgtt catgtcttat tttcttttt cctaatgtaa ctatgagagg cttaaaaact 60
gtaaaatcag caaaacaata tacaattaca gtaaaaaatg tcacatacta agttctatat 120
atgactacaa gtctacaact caactaatca tccacataaa taattagttt tgtcataatt 180
atattatagt aagtacctga agaaaagata aagccatttc tggacaacat catctcgtat 240
tggcatcttt atacgtggac gacaaaatct atcacaataa tagttgctag atatagatac 300

atgaattttg taatatgatt aattaattgg cgcttcataa ctaaaataac taataaaggg 360
taaatgttct taaagtttca taattaatta tgtttcagag tggttgcatt atagtagttt 420
aaaattcaga agtgtacgcg acgagaaaag agatttgctg gtgactattg catcatcttt 480
gacatggaaa aaatcttaga taagaatagt ttgaaattag aaagctcgca attgaggtct 540
accaaaatta gaaattagaa agctcgcaat ccagtcagca tcatcacacc aaaagttagg 600
cccgaatagt ttgaaattag aaagctcgca attgaggtct acaggccaaa ttcgctctta 660
gccgtacaat attactcacc ggtgcgatgc cccccatcgt aggtgaaggt ggaaattaat 720
ggcgcgcctg atcactgatt agtaactatt acgtaagcct acgtagcgtc acgtgacgtt 780
agctaacgct acgtagcctc agctgacgtt acgtaagcct acgtagcgtc acgtgagctt 840
agctaacgct acctaggctc agctgacgtt acgtaacgct agctagcgtc actcctgcag 900
caaatttaca cattgccact aaacgtctaa acccttgtaa tttgtttttg ttttactatg 960
tgtgttatgt atttgatttg cgataaattt ttatatttgg tactaaattt ataacacctt 1020
ttatgctaac gtttgccaac acttagcaat ttgcaagttg attaattgat tctaaattat 1080
ttttgtcttc taaatacata 1100

<210> 285
<211> 811
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 1 flanking sequence up to and including the left
border of the T-DNA

<400> 285
aatttttctg atttaggatt cacatgatcc aaaaaggaaa tccagaagca ctaatcagac 60
attggaagta ggattaatca gtgatcagta actattaaat tcaattaacc gcggacatct 120
acatttttga attgaaaaaa aattggtaat tactctttct ttttctccat attgaccatc 180
atactcattg ctgatccatg tagatttccc ggacatgaag ccatttactc tgaccctact 240
ccacaaatat atttttattt ataaaaaggt ggccattgta tactatgtgt gcgtatacag 300
gaataaaaat gtgtcaatgt atatgtaaac tgattccatc ttatatgtaa tgtgcgtgtg 360
taaatgaaga tactagtatc catgtgtcgc ctacttgatt tgttcaactg taactcataa 420
tatctcaaga ttctttcttt tttttctacg aatatcgcaa tctataatac cattaaatta 480
ttgtaacaaa attggttgac atttataaaa tgaaaaagaa gagaagagca tttaaacacg 540
actgatgaaa gtccaatgta gctagataaa ccacgcgtgg tggtcaatgc gttccattcc 600
aaaaggatcc gagttcgaat ccgcaccaca ccagattttc actgcgcgtg gccatgaagc 660
tttcgcattc tcgctcctga gaatggttct ccattttttt tttccagtgt agctagatac 720
cggtctgaat ctaggtttat aatatgctga caatgtaatg ataattaata catcaaaaca 780
tgtgtttctg aaccaaaata aaaacttttt t 811

<210> 286
<211> 27
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 1_Forward primer

<400> 286
ctctttcttt ttctccatat tgaccat 27

<210> 287
<211> 28
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 1_Reverse primer

<400> 287
acatttttat tcctgtatac gcacacat 28

<210> 288
<211> 19
<212> DNA
<213> Artificial sequence

<220>

<223> LBFLFK locus 1_Probe

<400> 288
atactcattg ctgatccat 19

<210> 289
<211> 47800
<212> DNA
<213> Artificial sequence

<220>
<223> contig of insert and flanking sequences of LBFLFK T-DNA Locus 2

<400> 289
gaaaaacctg catctccaaa aatgttcaaa tggcttaaaa acagagaaaa tgagtggaat 60
attagataga tctaccttta tagaacacac aaaaatacat atctaaaatt attaaatctt 120
cctttaaatg agtggaagat gagaaccatg tgatgaaaaa cctgcaaaac aagataaatt 180
agtaagaaaa acatgagaca gaaacaataa attgatataa agtttgatgt ttataagttc 240
aaagggatta aagagaggtt tgagagtttt agaacgagga acataccatt tttgttgcag 300
ccatttgaga ggagaagaga gaatgtgtaa atgttttttt atataaggag acaaaaattc 360
caataaggtt aaatattttt gatcagaaga cttactagac gacttacttg taagtcgccc 420
agaagacttc aatattttta gcgggaaact aaaatatttt tagcgggagt tagaagaccc 480
taaacataac ccttaaacta aattaactaa ctaaatactt cataaaatca aattaaactt 540
aaaaagtgtt tactatacac agaaataatc acatgtagat ataaatttaa tttttcaaaa 600
aaacatttaa gctttccaaa atctaaccct aagaatacat acaatactac aacatatgtt 660
gccaaaccct agaccaaaga atatcatgat tcactacttt cactcatcta tgttgaaaac 720
aattcaattt tattatatct taatttatat cacttaaaac tgtttataat tacatgattt 780
taattttccg tttatcaaaa tattttttac aaaatttata aattattttt aggatcaact 840
ataccagacg acttccatgg acgccgtaca gaagactaaa cagaatctca caagactcag 900
aagacgtagc ggggatatat tcataaaaat gagttctgtt tttttgtttg gtcacaaggg 960
gctggttgta atttcacaag gcttttggat tacttttgca tttgattcaa gtttgggtat 1020
acttttgcaa tcaaaatcaa gttttgagtc atatttggta aatcgcccta tataaaataa 1080
aattttaaaa agtaatgaat ctacatattt tgtaattttt aaaaaattta gttaacaatt 1140
ataataacac aaaacttaag aaaaagttat aattgtcgta ttttttttctc ttttcttttc 1200
tatgtaatat ttttatataa gtaataatgt gaatagaatt tatcaaatca tatgttagaa 1260
taattattat ataattttat acatttaaaa atttaaatat aatcaagata tatacatgta 1320
tttatatatt accagatcag agcagatatc cgtttcccaa aattttaata tttgtgattt 1380
gcttcgattt taatggatat tgatttttag tattttttttg cttcaaaagt ttatggatat 1440
tcggaatttt cggatcgaat cgaaacgaat aacgcatcaa atcaaattta acggataaaa 1500
ccttagtaac acatgcataa accttagtga acttctcaag ctttcgattc tctatcttat 1560
ttatctatga aattaattaa cataattttc cttgaattaa cataattgga ctaacgcata 1620
ttcgagctga agtcaaaatt cccaaaactt gttcttgata tgagtaaaac tgttcgtctg 1680
atgtaaactc ttactgtagt tgtattacaa actaatgata aagtatgcat tttctatttt 1740
attataaatt tacattacta gttgataaca tattgacaac tagaaagcgt gagagagaga 1800
tactcggtaa gccgagatgt atatccacag ttggagtctt tggatttcat atccagaatt 1860
gggtcgcaaa ctttcagtac aaagttatga catctccatg gtatatatcg acgtgtctat 1920
atatcatatt aaagaaaggt ttgtagtatt tggttaggta caaatgcgat caacttttga 1980
atttatatcc atgtacatat ataccccttgg ttacaaggac acctacccat acatacgcat 2040
aagtgacaaa tagcaaaata tctacacatc gcatgacccc gttctttttt atgataaggt 2100
tgtgattttt gtggttcttt tttttcatct cttacattga ttcagtatgt tgtccaaaaa 2160
aaaaacagtg attcagtatt atatcgagta aattcacaag aacgtagcta caatgtagat 2220
gatttattaa caattttaca agagacaagc aaatgtcgag caatcatatt ctataatatc 2280
aacctaaaag agttaaatcc ataaaattag ttggcaacga gcgatagtat gaaagttagg 2340
tgatgacaaa agttgctata ttgcttcaac tatattttca taaatttatt tgtctggatg 2400
aaaaccacaa aattttaaaa atataatttt gattggtaat atgtaaataa cgggatccta 2460
tatttaaacc agtcagcatc atcacaccaa aagttaggcc cgaatagttt gaaattagaa 2520
agctcgcaat tgaggtctac aggccaaatt cgctcttagc cgtacaatat tactcaccgg 2580
tgcgatgccc cccatcgtag gtgaaggtgg aaattaatgg cgcgcctgat cactgattag 2640
taactattac gtaagcctac gtagcgtcac gtgacgttag ctaacgctac gtagcctcag 2700
ctgacgttac gtaagcctac gtagcgtcac gtgagcttag ctaacgctac ctaggctcag 2760
ctgacgttac gtaacgctag ctagcgtcac tcctgcagca aatttacaca ttgccactaa 2820
acgtctaaac ccttgtaatt tgtttttgtt ttactatgtg tgttatgtat ttgatttgcg 2880
ataaattttt atatttggta ctaaatttat aacacctttt atgctaacgt ttgccaacac 2940
ttagcaattt gcaagttgat taattgattc taaattattt ttgtcttcta aatacatata 3000
ctaatcaact ggaaatgtaa atatttgcta atatttctac tataggagaa ttaaagtgag 3060
tgaatatggt accacaaggt ttggagattt aattgttgca atgctgcatg gatggcatat 3120
acaccaaaca ttcaataatt cttgaggata ataatggtac cacacaagat ttgaggtgca 3180
tgaacgtcac gtggacaaaa ggtttagtaa tttttcaaga caacaatgtt accacacaca 3240

agttttgagg tgcatgcatg gatgccctgt ggaaagttta aaaatatttt ggaaatgatt 3300
tgcatggaag ccatgtgtaa aaccatgaca tccacttgga ggatgcaata atgaagaaaa 3360
ctacaaattt acatgcaact agttatgcat gtagtctata taatgaggat tttgcaatac 3420
tttcattcat acacactcac taagttttac acgattataa tttcttcata gccagtactg 3480
tttaagcttc actgtctctg aatcggcaaa ggtaaacgta tcaattattc tacaaaccct 3540
tttatttttc ttttgaatta ccgtcttcat tggttatatg ataacttgat aagtaaagct 3600
tcaataattg aatttgatct gtgttttttt ggccttaata ctaaatcctt acataagctt 3660
tgttgcttct cctcttgtga gttgagtgtt aagttgtaat aatggttcac tttcagcttt 3720
agaagaaacc atggaagttg ttgagaggtt ctacggagag ttggatggaa aggtttccca 3780
aggagtgaac gctttgttgg gatctttcgg agttgagttg actgataccc caactactaa 3840
gggattgcca ctcgttgatt ctccaactcc aattgtgttg ggagtgtctg tttacttgac 3900
catcgtgatc ggaggattgc tttggatcaa ggctagagat ctcaagccaa gagcttctga 3960
gccattcttg ttgcaagctt tggtgttggt gcacaacttg ttctgcttcg ctttgtctct 4020
ttacatgtgc gtgggtatcg cttaccaagc tatcacctgg agatattcct tgtggggaaa 4080
cgcttataac ccaaagcaca aggagatggc tatcctcgtt tacctcttct acatgtccaa 4140
gtacgtggag ttcatggata ccgtgatcat gatcctcaag agatccacca gacagatttc 4200
tttcctccac gtgtaccacc actcttctat ctcccttatc tggtgggcta ttgctcacca 4260
cgctccagga ggagaggctt attggagtgc tgctctcaac tctggagtgc acgtgttgat 4320
gtacgcttac tacttcttgg ctgcttgctt gagatcttcc ccaaagctca agaacaagta 4380
cctcttctgg ggaagatacc tcacccaatt ccagatgttc cagttcatgc tcaacttggt 4440
gcaagcttac tacgatatga aaaccaacgc tccatatcca caatggctca tcaagatcct 4500
cttctactac atgatctccc tcttgttcct cttcggaaac ttctacgtgc aaaagtacat 4560
caagccatcc gatggaaagc aaaagggagc taagaccgag tgatcgacaa gctcgagttt 4620
ctccataata atgtgtgagt agttcccaga taagggaatt agggttccta tagggtttcg 4680
ctcatgtgtt gagcatataa gaaaccctta gtatgtattt gtatttgtaa aatacttcta 4740
tcaataaaat ttctaattcc taaaaccaaa atccagtact aaaatccaga tcccccgaat 4800
taattcggcg ttaattcagc tagctagcct cagctgacgt tacgtaacgc taggtagcgt 4860
cacgtgacgt tagctaacgc taggtagcgt cagctgagct tacgtaagcg cttagcagat 4920
atttggtgtc taaatgttta ttttgtgata tgttcatgtt tgaaatggtg gtttcgaaac 4980
cagggacaac gttgggatct gatagggtgt caaagagtat tatggattgg gacaatttcg 5040
gtcatgagtt gcaaattcaa gtatatcgtt cgattatgaa aattttcgaa gaatatccca 5100
tttgagagag tctttacctc attaatgttt ttagattatg aaattttatc atagttcatc 5160
gtagtctttt tggtgtaaag gctgtaaaaa gaaattgttc acttttgttt tcgtttatgt 5220
gaaggctgta aaagattgta aaagactatt ttggtgtttt ggataaaatg atagttttta 5280
tagattcttt tgcttttaga agaaatacat ttgaaatttt ttccatgttg agtataaaat 5340
accgaaatcg attgaagatc atagaaatat tttaactgaa aacaaattta taactgattc 5400
aattctctcc atttttatac ctatttaacc gtaatcgatt ctaatagatg atcgattttt 5460
tatataatcc taattaacca acggcatgta ttggataatt aaccgatcaa ctctcacccc 5520
taatagaatc agtattttcc ttcgacgtta attgatccta cactatgtag gtcatatcca 5580
tcgttttaat ttttggccac cattcaattc tgtcttgcct ttagggatgt gaatatgaac 5640
ggccaaggta agagaataaa aataatccaa attaaagcaa gagaggccaa gtaagataat 5700
ccaaatgtac acttgtcatt gccaaaatta gtaaaatact cggcatattg tattcccaca 5760
cattattaaa ataccgtata tgtattggct gcatttgcat gaataatact acgtgtaagc 5820
ccaaaagaac ccacgtgtag cccatgcaaa gttaacactc acgaccccat tcctcagtct 5880
ccactatata aacccaccat ccccaatctc accaaaccca ccacacaact cacaactcac 5940
tctcacacct taaagaacca atcaccacca aaaaatttca cgatttggaa tttgattcct 6000
gcgatcacag gtatgacagg ttagattttg ttttgtatag ttgtatacat acttctttgt 6060
gatgttttgt ttacttaatc gaatttttgg agtgttttaa ggtctctcgt ttagaaatcg 6120
tggaaaatat cactgtgtgt gtgttcttat gattcacagt gtttatgggt ttcatgttct 6180
ttgttttatc attgaatggg aagaaatttc gttgggatac aaatttctca tgttcttact 6240
gatcgttatt aggagtttgg ggaaaaagga agagtttttt tggttggttc gagtgattat 6300
gaggttattt ctgtatttga tttatgagtt aatggtcgtt ttaatgttgt agaccatggg 6360
aaaaggatct gagggaagat ctgctgctag agagatgact gctgaggcta acggagataa 6420
gagaaagacc atcctcattg agggagtgtt gtacgatgct accaacttca aacacccagg 6480
aggttccatt attaacttcc tcaccgaggg agaagctgga gttgatgcta cccaagctta 6540
cagagagttc catcagagat ccggaaaggc tgataagtac ctcaagtccc tcccaaagtt 6600
ggatgcttct aaggtggagt ctaggttctc tgctaaggag caggctagaa gggacgctat 6660
gaccagggat tacgctgctt tcagagagga gttggttgct gagggatact tcgatccatc 6720
tatcccacac atgatctaca gagtggtgga gattgtggct ttgttcgctt tgtctttctg 6780
gttgatgtct aaggcttctc caacctcttt ggttttggga gtggtgatga acggaatcgc 6840
tcaaggaaga tgcggatggg ttatgcacga gatgggacac ggatctttca ctggagttat 6900
ctggctcgat gataggatgt gcgagttctt ctacggagtt ggatgtggaa tgtctggaca 6960
ctactggaag aaccagcact ctaagcacca cgctgctcca aacagattgg agcacgatgt 7020
ggatttgaac accttgccac tcgttgcttt caacgagaga gttgtgagga aggttaagcc 7080
aggatctttg ttggctttgt ggctcagagt tcaggcttat ttgttcgctc cagtgtcttg 7140
cttgttgatc ggattgggat ggaccttgta cttgcaccca agatatatgc tcaggaccaa 7200
gagacacatg gagtttgtgt ggatcttcgc tagatatatc ggatggttct ccttgatggg 7260
agctttggga tattctcctg gaacttctgt gggaatgtac ctctgctctt tcggacttgg 7320

atgcatctac atcttcctcc aattcgctgt gtctcacacc cacttgccag ttaccaaccc 7380
agaggatcaa ttgcactggc ttgagtacgc tgctgatcac accgtgaaca tctctaccaa 7440
gtcttggttg gttacctggt ggatgtctaa cctcaacttc caaatcgagc accacttgtt 7500
cccaaccgct ccacaattca ggttcaagga gatctctcca agagttgagg ctctcttcaa 7560
gagacacaac ctcccttact acgatttgcc atacacctct gctgtttcta ctaccttcgc 7620
taacctctac tctgttggac actctgttgg agctgatacc aagaagcagg attgactgct 7680
ttaatgagat atgcgagacg cctatgatcg catgatattt gctttcaatt ctgttgtgca 7740
cgttgtaaaa aacctgagca tgtgtagctc agatccttac cgccggtttc ggttcattct 7800
aatgaatata tcacccgtta ctatcgtatt tttatgaata atattctccg ttcaatttac 7860
tgattgtcta cgtaggctca gctgagctta cctaaggcta cgtaggctca cgtgacgtta 7920
cgtaaggcta cgtagcgtca cgtgagctta cctaactcta gctagcctca cgtgacctta 7980
gctaacacta ggtagcgtca gctcgacggc ccggactgta tccaacttct gatctttgaa 8040
tctctctgtt ccaacatgtt ctgaaggagt tctaagactt ttcagaaagc ttgtaacatg 8100
ctttgtagac tttctttgaa ttactcttgc aaactctgat tgaacctacg tgaaaactgc 8160
tccagaagtt ctaaccaaat tccgtcttgg gaaggcccaa aatttattga gtacttcagt 8220
ttcatggacg tgtcttcaaa gatttataac ttgaaatccc atcattttta agagaagttc 8280
tgttccgcaa tgtcttagat ctcattgaaa tctacaactc ttgtgtcaga agttcttcca 8340
gaatcaactt gcatcatggt gaaaatctgg ccagaagttc tgaacttgtc atatttctta 8400
acagttagaa aaatttctaa gtgtttagaa ttttgacttt tccaaagcaa acttgacttt 8460
tgactttctt aataaaacaa acttcatatt ctaacatgtc ttgatgaaat gtgattcttg 8520
aaatttgatg ttgatgcaaa agtcaaagtt tgacttttca gtgtgcaatt gaccattttg 8580
ctcttgtgcc aattccaaac ctaaattgat gtatcagtgc tgcaaacttg atgtcatgga 8640
agatcttatg agaaaattct tgaagactga gaggaaaaat tttgtagtac aacacaaaga 8700
atcctgtttt tcatagtcgg actagacaca ttaacataaa acaccacttc attcgaagag 8760
tgattgaaga aggaaatgtg cagttacctt tctgcagttc ataagagcaa cttacagaca 8820
cttttactaa aatactacaa agaggaagat tttaacaact tagagaagta atgggagtta 8880
aagagcaaca cattaagggg gagtgttaaa attaatgtgt tgtaaccacc actaccttta 8940
gtaagtatta taagaaaatt gtaatcatca cattataatt attgtcctta tttaaaatta 9000
tgataaagtt gtatcattaa gattgagaaa accaaatagt cctcgtcttg atttttgaat 9060
tattgttttc tatgttactt ttcttcaagc ctatataaaa actttgtaat gctaaattgt 9120
atgctggaaa aaaatgtgta atgaattgaa tagaaattat ggtatttcaa agtccaaaat 9180
ccatcaatag aaatttagta caaaacgtaa ctcaaaaata ttctcttatt ttaaatttta 9240
caacaatata aaaatattct cttattttaa attttacaat aatataattt atcacctgtc 9300
acctttagaa taccaccaac aatattaata cttagatatt ttattcttaa taattttgag 9360
atctctcaat atatctgata tttattttat atttgtgtca tattttctta tgttttagag 9420
ttaaccctta tatcttggtc aaactagtaa ttcaatatat gagtttgtga aggacacatt 9480
gacatcttga aacattggtt ttaaccttgt tggaatgtta aaggtaataa aacattcaga 9540
attatgacca tctattaata tacttccttt gtcttttaaa aaagtgtgca tgaaaatgct 9600
ctatggtaag ctagagtgtc ttgctggcct gtgtatatca attccatttc cagatggtag 9660
aaactgccac tacgaataat tagtcataag acacgtatgt taacacacgt ccccttgcat 9720
gttttttgcc atatattccg tctctttctt tttcttcacg tataaaacaa tgaactaatt 9780
aatagagcga tcaagctgaa cagttctttg ctttcgaagt tgccgcaacc taaacaggtt 9840
tttccttctt ctttcttctt attaactacg accttgtcct ttgcctatgt aaaattacta 9900
ggttttcatc agttacactg attaagttcg ttatagtgga agataaaatg ccctcaaagc 9960
attttgcagg atatctttga tttttcaaag atatggaact gtagagtttg atagtgttct 10020
tgaatgtggt tgcatgaagt ttttttggtc tgcatgttat tttttcctcg aaatatgttt 10080
tgagtccaac aagtgattca cttgggattc agaaagttgt tttctcaata tgtaacagtt 10140
tttttctatg gagaaaaatc atagggaccg ttggttttgg cttctttaat tttgagctca 10200
gattaaaccc attttacccg gtgttcttgg cagaattgaa aacagtacgt agtaccgcgc 10260
ctaccatgtg tgttgagacc gagaacaacg atggaatccc tactgtggag atcgctttcg 10320
atggagagag agaaagagct gaggctaacg tgaagttgtc tgctgagaag atggaacctg 10380
ctgctttggc taagaccttc gctagaagat acgtggttat cgagggagtt gagtacgatg 10440
tgaccgattt caaacatcct ggaggaaccg tgattttcta cgctctctct aacactggag 10500
ctgatgctac tgaggctttc aaggagttcc accacagatc tagaaaggct aggaaggctt 10560
tggctgcttt gccttctaga cctgctaaga ccgctaaagt ggatgatgct gagatgctcc 10620
aggatttcgc taagtggaga aaggagttgg agagggacgg attcttcaag ccttctcctg 10680
ctcatgttgc ttacagattc gctgagttgg ctgctatgta cgctttggga acctacttga 10740
tgtacgctag atacgttgtg tcctctgtgt tggtttacgc ttgcttcttc ggagctagat 10800
gtggatgggt tcaacacgag ggaggacact cttctttgac cggaaacatc tggtgggata 10860
agagaatcca agctttcact gctggattcg gattggctgg atctggagat atgtggaact 10920
ccatgcacaa caagcaccac gctactcctc aaaaagtgag gcacgatatg gatttggata 10980
ccactcctgc tgttgctttc ttcaacaccg ctgtggagga taatagacct aggggattct 11040
ctaagtactg gctcagattg caagcttgga ccttcattcc tgtgacttct ggattggtgt 11100
tgctcttctg gatgttcttc ctccaccctt ctaaggcttt gaagggagga aagtacgagg 11160
agcttgtgtg gatgttggct gctcacgtga ttagaacctg gaccattaag gctgttactg 11220
gattcaccgc tatgcaatcc tacggactct tcttggctac ttcttgggtt tccggatgct 11280
acttgttcgc tcacttctct acttctcaca cccacttgga tgttgttcct gctgatgagc 11340
acttgtcttg ggttaggtac gctgtggatc acaccattga tatcgatcct tctcagggat 11400

```
gggttaactg gttgatggga tacttgaact gccaagtgat tcaccacctc ttcccttcta  11460
tgcctcaatt cagacaacct gaggtgtcca gaagattcgt tgctttcgct aagaagtgga  11520
acctcaacta caaggtgatg acttatgctg gagcttggaa ggctactttg ggaaacctcg  11580
ataatgtggg aaagcactac tacgtgcacg gacaacactc tggaaagacc gcttgattaa  11640
tgaaggccgc ctcgaccgta ccccctgcag atagactata ctatgtttta gcctgcctgc  11700
tggctagcta ctatgttatg ttatgttgta aaataaacac ctgctaaggt atatctatct  11760
atattttagc atggctttct caataaattg tctttcctta tcgtttacta tcttatacct  11820
aataatgaaa taataatatc acatatgagg aacggggcag gtttaggcat atatatacga  11880
gtgtagggcg gagtggggct acgtagcgtc acgtgacgtt acctaagcct aggtagcctc  11940
agctgacgtt acgtaacgct aggtaggctc agctgacacg ggcaggacat agggactact  12000
acaagcatag tatgcttcag acaaagagct aggaaagaac tcttgatgga ggttaagaga  12060
aaaaagtgct agaggggcat agtaatcaaa cttgtcaaaa ccgtcatcat gatgagggat  12120
gacataatat aaaaagttga ctaaggtctt ggtagtactc tttgattagt attatatatt  12180
ggtgagaaca tgagtcaaga ggagacaaga aaccgaggaa ccatagttta gcaacaagat  12240
ggaagttgca aagttgagct agccgctcga ttagttacat ctcctaagca gtactacaag  12300
gaatggtctc tatactttca tgtttagcac atggtagtgc ggattgacaa gttagaaaca  12360
gtgcttagga gacaaagagt cagtaaaggt attgaaagag tgaagttgat gctcgacagg  12420
tcaggagaag tccctccgcc agatggtgac taccaagggg ttggtatcag ctgagaccca  12480
aataagattc ttcggttgaa ccagtggttc gaccgagact cttagggtgg gatttcactg  12540
taagatttgt gcattttgtt gaatataaat tgacaatttt ttttatttaa ttatagatta  12600
tttagaatga attacatatt tagtttctaa caaggatagc aatggatggg tatgggtaca  12660
ggttaaacat atctattacc cacccatcta gtcgtcgggt tttacacgta cccacccgtt  12720
tacataaacc agaccggaat tttaaaccgt acccgtccgt tagcgggttt cagatttacc  12780
cgtttaatcg ggtaaaacct gattactaaa tatatatttt ttatttgata aacaaaacaa  12840
aaatgttaat attttcatat tggatgcaat tttaagaaac acatattcat aaatttccat  12900
atttgtagga aaataaaaag aaaaatatat tcaagaacac aaatttcacc gacatgactt  12960
ttattacaga gttggaatta gatctaacaa ttgaaaaatt aaaattaaga tagaatatgt  13020
tgaggaacat gacatagtat aatgctgggt tacccgtcgg gtaggtatcg aggcggatac  13080
tactaaatcc atcccactcg ctatccgata atcactggtt tcgggtatac ccattcccgt  13140
caacaggcct ttttaaccgg ataatttcaa cttatagtga atgaattttg aataaatagt  13200
tagaatacca aaatcctgga ttgcatttgc aatcaaattt tgtgaaccgt taaattttgc  13260
atgtacttgg gatagatata atagaaccga attttcatta gtttaattta taacttactt  13320
tgttcaaaga aaaaaaatat ctatccaatt tacttataat aaaaaataat ctatccaagt  13380
tacttattat aatcaacttg taaaaaggta agaatacaaa tgtggtagcg tacgtgtgat  13440
tatatgtgac gaaatgttat atctaacaaa agtccaaatt cccatggtaa aaaaaatcaa  13500
aatgcatggc aggctgtttg taaccttgga ataagatgtt ggccaattct ggagccgcca  13560
cgtacgcaag actcagggcc acgttctctt catgcaagga tagtagaaca ccactccacc  13620
cacctcctat attagacctt tgcccaaccc tccccaactt tcccatccca tccacaaaga  13680
aaccgacatt tttatcataa atctggtgct taaacactct ggtgagttct agtacttctg  13740
ctatgatcga tctcattacc atttcttaaa tttctctccc taaatattcc gagttcttga  13800
tttttgataa cttcaggttt tctcttttttg ataaatctgg tctttccatt tttttttttt  13860
gtggttaatt tagtttccta tgttcttcga ttgtattatg catgatctgt gtttggattc  13920
tgttagatta tgtattggtg aatatgtatg tgtttttgca tgtctggttt tggtcttaaa  13980
aatgttcaaa tctgatgatt tgattgaagc ttttttagtg ttggtttgat tcttctcaaa  14040
actactgtta atttactatc atgttttcca actttgattc atgatgacac ttttgttctg  14100
ctttgttata aaattttggt tggtttgatt ttgtaattat agtgtaattt tgttaggaat  14160
gaacatgttt taatactctg ttttcgattt gtcacacatt cgaattatta atcgataatt  14220
taactgaaaa ttcatggttc tagatcttgt tgtcatcaga ttatttgttt cgataattca  14280
tcaaatatgt agtccttttg ctgatttgcg actgtttcat tttttctcaa aattgttttt  14340
tgttaagttt atctaacagt tatcgttgtc aaaagtctct ttcattttgc aaaatcttct  14400
tttttttttt gtttgtaact ttgtttttta agctacacat ttagtctgta aaatagcatc  14460
gaggaacagt tgtcttagta gacttgcatg ttcttgtaac ttctatttgt ttcagtttgt  14520
tgatgactgc tttgattttg taggtcaaag gcgcacccta ccatggatgc ttataacgct  14580
gctatggata agattggagc tgctatcatc gattggagtg atccagatgg aaagttcaga  14640
gctgataggg aggattggtg gttgtgcgat ttcagatccg ctatcaccat tgctctcatc  14700
tacatcgctt tcgtgatctt gggatctgct gtgatgcaat ctctcccagc tatggaccca  14760
taccctatca agttcctcta caacgtgtct caaatcttcc tctgcgctta catgactgtt  14820
gaggctggat tcctcgctta taggaacgga tacaccgtta tgccatgcaa ccacttcaac  14880
gtgaacgatc caccagttgc taacttgctc tggctcttct acatctccaa agtgtgggat  14940
ttctgggata ccatcttcat tgtgctcgga aagaagtgga gacaactctc tttcttgcac  15000
gtgtaccacc acaccaccat cttcctcttc tactggttga acgctaacgt gctctacgat  15060
ggagatatct tcttgaccat cctcctcaac ggattcattc acaccgtgat gtacacctac  15120
tacttcatct gcatgcacac caaggattct aagaccggaa agtctttgcc aatctggtgg  15180
aagtcatctt tgaccgcttt ccaactcttg caattcacca tcatgatgtc ccaagctacc  15240
tacttggttt tccacggatg cgataaggtt tccctcagaa tcaccatcgt gtacttcgtg  15300
tacattctct ccctttctt cctcttcgct cagttcttcg tgcaatccta catggctcca  15360
aagaagaaga agtccgcttg atgttaatga aggccgcaga tatcagatct ggtcgaccta  15420
gaggatcccc ggccgcaaag ataataacaa aagcctacta tataacgtac atgcaagtat  15480
```

tgtatgatat taatgttttt acgtacgtgt aaacaaaaat aattacgttt gtaacgtatg 15540
gtgatgatgt ggtgcactag gtgtaggcct tgtattaata aaaagaagtt tgttctatat 15600
agagtggttt agtacgacga tttatttact agtcggattg gaatagagaa ccgaattctt 15660
caatccttgc ttttgatcaa gaattgaaac cgaatcaaat gtaaaagttg atatatttga 15720
aaaacgtatt gagcttatga aaatgctaat actctcatct gtatggaaaa gtgactttaa 15780
aaccgaactt aaaagtgaca aaaggggaat atcgcatcaa accgaatgaa accgatctac 15840
gtaggctcag ctgagcttag ctaagcctac ctagcctcac gtgagattat gtaaggctag 15900
gtagcgtcac gtgacgttac ctaacactag ctagcgtcag ctgagcttag ctaaccctac 15960
gtagcctcac gtgagcttac ctaacgctac gtagcctcac gtgactaagg atgacctacc 16020
cattcttgag acaaatgtta cattttagta tcagagtaaa atgtgtacct ataactcaaa 16080
ttcgattgac atgtatccat tcaacataaa attaaaccag cctgcacctg catccacatt 16140
tcaagtattt tcaaaccgtt cggctcctat ccaccgggtg taacaagacg gattccgaat 16200
ttggaagatt ttgactcaaa ttcccaattt atattgaccg tgactaaatc aactttaact 16260
tctataattc tgattaagct cccaatttat attcccaacg gcactacctc caaaatttat 16320
agactctcat ccccttttaa accaacttag taaacgtttt ttttttaatt ttatgaagtt 16380
aagtttttac cttgttttta aaaagaatcg ttcataagat gccatgccag aacattagct 16440
acacgttaca catagcatgc agccgcggag aattgttttt cttcgccact tgtcactccc 16500
ttcaaacacc taagagcttc tctctcacag cacacacata caatcacatg cgtgcatgca 16560
ttattacacg tgatcgccat gcaaatctcc tttatagcct ataaattaac tcatcggctt 16620
cactctttac tcaaaccaaa actcatcaat acaaacaaga ttaaaaacat ttcacgattt 16680
ggaatttgat tcctgcgatc acaggtatga caggttagat tttgttttgt atagttgtat 16740
acatacttct ttgtgatgtt ttgtttactt aatcgaattt ttggagtgtt ttaaggtctc 16800
tcgtttagaa atcgtggaaa atatcactgt gtgtgtgttc ttatgattca cagtgtttat 16860
gggtttcatg ttctttgttt tatcattgaa tgggaagaaa tttcgttggg atacaaattt 16920
ctcatgttct tactgatcgt tattaggagt ttggggaaaa aggaagagtt tttttggttg 16980
gttcgagtga ttatgaggtt atttctgtat ttgatttatg agttaatggt cgttttaatg 17040
ttgtagaccg ccatggctat tttgaaccct gaggctgatt ctgctgctaa cctcgctact 17100
gattctgagg ctaagcaaag acaattggct gaggctggat acactcacgt tgagggtgct 17160
cctgctcctt tgcctttgga gttgcctcac ttctctctca gagatctcag agctgctatt 17220
cctaagcact gcttcgagag atctttcgtg acctccacct actacatgat caagaacgtg 17280
ttgacttgcg ctgctttgtt ctacgctgct accttcattg atagagctgg agctgctgct 17340
tatgttttgt ggcctgtgta ctggttcttc cagggatctt acttgactgg agtgtgggtt 17400
atcgctcacg agtgtggaca ccaggcttat tgctcttctg aggtggtgaa caacttgatt 17460
ggactcgtgt tgcactctgc tttgttggtg ccttaccact cttggagaat ctctcacaga 17520
aagcaccact ccaacactgg atcttgcgag aacgatgagg ttttcgttcc tgtgaccaga 17580
tctgtgttgg cttcttcttg gaacgagacc ttggaggatt ctcctctcta ccaactctac 17640
cgtatcgtgt acatgttggt tgttggatgg atgcctggat acctcttctt caacgctact 17700
ggacctacta agtactgggg aaagtctagg tctcacttca acccttactc cgctatctat 17760
gctgataggg agaggtggat gatcgtgctc tccgatattt tcttggtggc tatgttggct 17820
gttttggctg ctttggtgca cactttctcc ttcaacacga tggtgaagtt ctacgtggtg 17880
ccttacttca ttgtgaacgc ttacttggtg ttgattacct acctccaaca caccgatacc 17940
tacatccctc acttcagaga gggagagtgg aattggttga gaggagcttt gtgcactgtg 18000
gatagatcat ttggtccatt cctcgattct gtggtgcata gaatcgtgga tacccacgtt 18060
tgccaccata tcttctccaa gatgcctttc tatcactgcg aggaggctac caacgctatt 18120
aagcctctcc tcggaaagtt ctacttgaag gatactactc ctgttcctgt tgctctctgg 18180
agatcttaca cccactgcaa gttcgttgag gatgatggaa aggtggtgtt ctacaagaac 18240
aagttatagt taatgaataa ttgattggtt cgagtattat ggcattggga aaactgtttt 18300
tcttgtacca tttgttgtgc ttgtaattta ctgtgttttt tattcggttt tcgctatcga 18360
actgtgaaat ggaaatggat ggagaagagt taatgaatga tatggtcctt ttgttcattc 18420
tcaaattaat attatttgtt ttttctctta tttgttgtgt gttgaatttg aaattataag 18480
agatatgcaa acattttgtt ttgagtaaaa atgtgtcaaa tcgtggcctc taatgaccga 18540
agttaatatg aggagtaaaa cacttgtagt tgtaccatta tgcttattca ctaggcaaca 18600
aatatatttt cagacctaga aaagctgcaa atgttactga atacaagtat gtcctcttgt 18660
gttttagaca tttatgaact ttcctttatg taattttcca gaatccttgt cagattctaa 18720
tcattgcttt ataattatag ttatactcat ggatttgtag ttgagtatga aaatattttt 18780
taatgcattt tatgacttgc caattgattg acaacatgca tcaatctagc tagcctcagc 18840
tgacgttacg taacgctagg tagcgtcacg tgacgttagc taacgctagg tagcgtcagc 18900
tgagcttacg taagcgcaca gatgaatact agctgttgtt cacagttcta gtgtctcctc 18960
attacgtgaa ttcaagctac gatcactatc tcaactccta cataaacatc agaatgctac 19020
aaaactatgc acaaaaacaa aagctacatc taatacgtga atcaattact ctcatcacaa 19080
gaaagaagat ttcaatcacc gtcgagaagg aggattcagt taattgaatc aaagttccga 19140
tcaaactcga agactggtga gcacgaggac gacgaagaag agtgtctcga agatacaaca 19200
agcaagaaat ctactgagtg acctcctgaa gttattggcg cgattgagag aatcaatccg 19260
aattaatttc ggggaaaaag ataaattaga tactaagcga tgggcttggg ctgggctaag 19320
aaacaggtgg caattgggct ggaggacccc gcgattcata gcttccgata gcccaaaaaa 19380
aaacggataa catatttatc gggtatttga atttcagtga aataagatat tttctttttg 19440
ttaggaaaat tttagaaaat aatggaaatt aaatagcgat tatgttacaa gatacgatca 19500
gcatcgggca gtgcaaaatg ctatagcttc ccaagatttg atccttttgg gttatctcct 19560

```
aatgacaatt agtttaggat tttgaaactt atattaatac tattatccga caacacttgt  19620
ttcagcttct tattttaaca ttttttgttt ttttctattc ttcttcccat cagcattttc  19680
tttttaaaaa attgaatact ttaacttttt aaaaatttca caatgatcag atgatattat  19740
ggaagatctc aagagttaaa tgtatccatc ttggggcatt aaaaccggtg tacgggatga  19800
taaatacaga ctttatatca tatgatagct cagtaattca tatttatcac gttgctaaaa  19860
aaattataag gtactagtag tcaacaaaat caattaaaga gaaagaaaga aacgcatgtg  19920
aagagagttt acaactggaa aagtaaaata aaaattaacg catgttgaat gctgacatgt  19980
cagtatgtcc atgaatccac gtatcaagcg ccattcatcg atcgtcttcc tctttctaaa  20040
tgaaaacaac ttcacacatc acaacaaaca atacacacaa gaccccctct ctctcgttgt  20100
ctctctgcca gcgaccaaat cgaagcttga gaagaacaag aaggggtcaa accatggctt  20160
ctacatctgc tgctcaagac gctgctcctt acgagttccc ttctctcact gagatcaaga  20220
gggctcttcc ttctgagtgt ttcgaggctt ctgttcctct ttctctctac tacaccgcta  20280
gatctcttgc tcttgctgga tctctcgctg ttgctctctc ttacgctaga gctttgcctc  20340
ttgttcaggc taacgctctt cttgatgcta ctctctgcac tggatacgtt cttctccagg  20400
gaatcgtttt ctggggattc ttcaccgttg gtcacgattg tggacacgga gctttctcta  20460
gatctcacgt gctcaacttc tctgttggaa ccctcatgca ctctatcatc cttacccctt  20520
tcgagtcttg gaagctctct cacagacacc accacaagaa caccggaaac atcgataagg  20580
acgagatctt ctaccctcaa agagaggctg attctcaccc tgtttctaga caccttgtga  20640
tgtctcttgg atctgcttgg ttcgcttacc ttttcgctgg attccctcct agaaccatga  20700
accacttcaa cccttgggag gctatgtatg ttagaagagt ggctgctgtg atcatctctc  20760
tcggagttct tttcgctttc gctggactct actcttacct caccttcgtt cttggattca  20820
ccactatggc tatctactac ttcggacctc tcttcatctt cgctaccatg cttgttgtta  20880
ccactttcct ccaccacaac gatgaggaga caccttggta cgctgattct gagtggactt  20940
acgtgaaggg aaacctctct tctgtggaca gatcttacgg tgctctcatc gacaacctta  21000
gccacaacat cggaactcac cagatccacc acctcttccc tatcatccct cactacaagc  21060
tcaacgatgc tactgctgct ttcgctaagg ctttccctga gcttgttagg aaaaacgctg  21120
ctcctatcat cccaactttc ttcaggatgg ctgctatgta cgctaagtac ggagttgttg  21180
acactgatgc taagaccttc actctcaagg aggctaaggc tgctgctaag actaagtcat  21240
cttgatgatt aatgaataat tgattgtaca tactatattt tttgtttacc ttgtgttagt  21300
ttaatgttca gtgtcctctc tttattgtgg cacgtctctt tgttgtatgt tgtgtctata  21360
caaagttgaa ataatggaaa gaaaaggaag agtgtaattt gttttgtttt aagtgtttat  21420
aaatatatat atataggtca tttagatagt tctaggtttc tataaaactc tctctctgga  21480
agtagaatct gtttttgaga ggatccagtt gcctactaat ctcccccaaa acccttcaag  21540
cttaaccttc ctcttcacaa caacagagga aacacatctc ttgagctctg agttctcttc  21600
tttgagcatg tctatcgcta aactcatctg ccttatagct tccctcttct cttcatctct  21660
ctctctcacc atttcgctgt aaaacttatt ctcctccctc agcctctcta tctcttcctt  21720
cagcatctca caattcccac cataatcgac tgaggatgat tcaccgtcat caacttcaga  21780
ctcagcgttg tagtcgtcat gagtctcaca agccttggac caagaagact catcatcgca  21840
agttgatgat ttatcatgat gcttctctga gccgtgtttg ctacgtagcg tcacgtgacg  21900
ttacctaagc ctaggtagcc tcagctgacg ttacgtaacg ctaggtaggc tcagctgact  21960
gcagcaaatt tacacattgc cactaaacgt ctaaaccctt gtaatttgtt tttgttttac  22020
tatgtgtgtt atgtatttga tttgcgataa atttttatat ttggtactaa atttataaca  22080
ccttttatgc taacgtttgc caacacttag caatttgcaa gttgattaat tgattctaaa  22140
ttatttttgt cttctaaata catatactaa tcaactggaa atgtaaatat ttgctaatat  22200
ttctactata ggagaattaa agtgagtgaa tatggtacca caaggtttgg agatttaatt  22260
gttgcaatgc tgcatggatg gcatatacac caaacattca ataattcttg aggataataa  22320
tggtaccaca caagatttga ggtgcatgaa cgtcacgtgg acaaaaggtt tagtaatttt  22380
tcaagacaac aatgttacca cacacaagtt ttgaggtgca tgcatggatg ccctgtggaa  22440
agtttaaaaa tattttggaa atgatttgca tggaagccat gtgtaaaacc atgacatcca  22500
cttggaggat gcaataatga agaaaactac aaatttacat gcaactagtt atgcatgtag  22560
tctatataat gaggatttg caatactttc attcatacac actcactaag ttttacacga  22620
ttataatttc ttcatagcca gtactgttta agcttcactg tctctgaatc ggcaaaggta  22680
aacgtatcaa ttattctaca aaccctttta tttttctttt gaattaccgt cttcattggt  22740
tatatgataa cttgataagt aaagcttcaa taattgaatt tgatctgtgt ttttttggcc  22800
ttaatactaa atccttacat aagctttgtt gcttctcctc ttgtgagttg agtgttaagt  22860
tgtaataatg gttcactttc agctttagaa gaaacgcgcc ttccatggct acaaaggagg  22920
cttacgtttt cccaactctc accgagatca agagatctct cccaaaggat tgcttcgagg  22980
cttctgtgcc tttgtctctc tactacactg tgagatgctt ggttattgct gtggctttga  23040
ccttcggatt gaactacgct agagctttgc cagaggttga gtctttctgg gctttggatg  23100
ctgctttgtg cactggatat atcctcctcc agggaattgt gttctgggga ttcttcactg  23160
ttggacacga tgctggacac ggagctttct ctagatacca cctcttgaac ttcgttgtgg  23220
gaaccttcat gcactctctc atcttgaccc cattcgagtc ttggaagttg acccacagac  23280
accaccacaa gaacaccgga aacatcgata gagatgaggt gttctaccca cagagaaagg  23340
ctgatgatca cccattgtcc aggaacttga tcttggcttt gggagctgct tggcttgctt  23400
atttggtgga gggattccca ccaagaaagg tgaaccactt caacccattc gagccacttt  23460
ttgtgagaca agtgtccgct gtggttatct ctttgctcgc tcacttcttc gttgctggac  23520
tctctatcta cttgtctctc cagttgggac ttaagaccat ggctatctac tactacggac  23580
cagttttcgt gttcggatct atgttggtga ttaccacctt cttgcaccac aacgatgagg  23640
```

agactccatg gtatgctgat tctgagtgga cttacgtgaa gggaaacttg tcctctgtgg 23700
atagatctta cggtgctctc atcgataacc tctcccacaa catcggaact caccagatcc 23760
accacctctt cccaattatc ccacactaca agctcaagaa ggctactgct gctttccacc 23820
aagctttccc agagcttgtg agaaagtccg atgagccaat catcaaggct ttcttcagag 23880
tgggaaggtt gtatgctaac tacggagtgg ttgatcaaga ggctaagctc ttcactttga 23940
aggaggctaa ggctgctact gaagctgctg ctaagaccaa gtctacctga ttaatgaatc 24000
gacaagctcg agtttctcca taataatgtg tgagtagttc ccagataagg gaattagggt 24060
tcctataggg tttcgctcat gtgttgagca tataagaaac ccttagtatg tatttgtatt 24120
tgtaaaatac ttctatcaat aaaatttcta attcctaaaa ccaaaatcca gtactaaaat 24180
ccagatcccc cgaattaatt cggcgttaat tcagctacgt aggctcagct gagcttacct 24240
aaggctacgt aggctcacgt gacgttacgt aaggctacgt agcgtcacgt gagcttacct 24300
aactctagct agcctcacgt gaccttagct aacactaggt agcgtcagca cagatgaata 24360
ctagctgttg ttcacagttc tagtgtctcc tcattacgtg aattcaagct acgatcacta 24420
tctcaactcc tacataaaca tcagaatgct acaaaactat gcacaaaaac aaaagctaca 24480
tctaatacgt gaatcaatta ctctcatcac aagaaagaag atttcaatca ccgtcgagaa 24540
ggaggattca gttaattgaa tcaaagttcc gatcaaactc gaagactggt gagcacgagg 24600
acgacgaaga agagtgtctc gaagatacaa caagcaagaa atctactgag tgacctcctg 24660
aagttattgg cgcgattgag agaatcaatc cgaattaatt tcggggaaaa agataaatta 24720
gatactaagc gatgggcttg ggctgggcta agaaacaggt ggcaattggg ctggaggacc 24780
ccgcgattca tagcttccga tagcccaaaa aaaaacggat aacatattta tcgggtattt 24840
gaatttcagt gaaataagat attttctttt tgttaggaaa attttagaaa ataatggaaa 24900
ttaaatagcg attatgttac aagatacgat cagcatcggg cagtgcaaaa tgctatagct 24960
tcccaagatt tgatcctttt gggttatctc ctaatgacaa ttagtttagg attttgaaac 25020
ttatattaat actattatcc gacaacactt gtttcagctt cttattttaa cattttttgt 25080
tttttctat tcttcttccc atcagcattt tctttttaaa aaattgaata ctttaacttt 25140
ttaaaaattt cacaatgatc agatgatatt atggaagatc tcaagagtta aatgtatcca 25200
tcttggggca ttaaaaccgg tgtacgggat gataaataca gactttatat catatgatag 25260
ctcagtaatt catatttatc acgttgctaa aaaaattata aggtactagt agtcaacaaa 25320
atcaattaaa gagaaagaaa gaaacgcatg tgaagagagt ttacaactgg aaaagtaaaa 25380
taaaaattaa cgcatgttga atgctgacat gtcagtatgt ccatgaatcc acgtatcaag 25440
cgccattcat cgatcgtctt cctctttcta aatgaaaaca acttcacaca tcacaacaaa 25500
caatacacac aagacccccct ctctctcgtt gtctctctgc cagcgaccaa atcgaagctt 25560
gagaagaaca agaaggggtc aaaccatggg aaaaggatct gagggaagat ctgctgctag 25620
agagatgact gctgaggcta acggagataa gagaaagacc atcctcattg agggagtgtt 25680
gtacgatgct accaacttca aacacccagg aggttccatt attaacttcc tcaccgaggg 25740
agaagctgga gttgatgcta cccaagctta cagagagttc catcagagat ccggaaaggc 25800
tgataagtac ctcaagtccc tcccaaagtt ggatgcttct aaggtggagt ctaggttctc 25860
tgctaaggag caggctagaa gggacgctat gaccagggat tacgctgctt tcagagagga 25920
gttggttgct gagggatact tcgatccatc tatcccacac atgatctaca gagtggtgga 25980
gattgtggct ttgttcgctt tgtctttctg gttgatgtct aaggcttctc caacctcttt 26040
ggttttggga gtggtgatga acggaatcgc tcaaggaaga tgcggatggg ttatgcacga 26100
gatgggacac ggatctttca ctggagttat ctggctcgat gataggatgt gcgagttctt 26160
ctacggagtt ggatgtggaa tgtctggaca ctactggaag aaccagcact ctaagcacca 26220
cgctgctcca aacagattgg agcacgatgt ggatttgaac accttgccac tcgttgcttt 26280
caacgagaga gttgtgagga aggttaagcc aggatctttg ttggctttgt ggctcagagt 26340
tcaggcttat ttgttcgctc cagtgtcttg cttgttgatc ggattgggat ggaccttgta 26400
cttgcaccca agatatatgc tcaggaccaa gagacacatg gagtttgtgt ggatcttcgc 26460
tagatatatc ggatggttct ccttgatggg agctttggga tattctcctg gaacttctgt 26520
gggaatgtac ctctgctctt tcggacttgg atgcatctac atcttcctcc aattcgctgt 26580
gtctcacacc cacttgccag ttaccaaccc agaggatcaa ttgcactggc ttgagtacgc 26640
tgctgatcac accgtgaaca tctctaccaa gtcttggttg gttacctggt ggatgtctaa 26700
cctcaacttc caaatcgagc accacttgtt cccaaccgct ccacaattca ggttcaagga 26760
gatctctcca agagttgagg ctctcttcaa gagacacaac ctcccttact acgatttgcc 26820
atacacctct gctgtttcta ctaccttcgc taacctctac tctgttggac actctgttgg 26880
agctgatacc aagaagcagg attgatgatt aatgaataat tgattgtaca tactatattt 26940
tttgtttacc ttgtgttagt ttaatgttca gtgtcctctc tttattgtgg cacgtctctt 27000
tgttgtatgt tgtgtctata caaagttgaa ataatggaaa gaaaaggaag agtgtaattt 27060
gttttgtttt aagtgtttat aaatatatat atataggtca tttagatagt tctaggtttc 27120
tataaaactc tctctctgga agtagaatct gtttttgaga ggatccagtt gcctactaat 27180
ctcccccaaa acccttcaag cttaaccttc ctcttcacaa caacagagga aacacatctc 27240
ttgagctctg agttctcttc tttgagcatg tctatcgcta aactcatctg ccttatagct 27300
tccctcttct cttcatctct ctctctcacc atttcgctgt aaaacttatt ctcctccctc 27360
agcctctcta tctcttcctt cagcatctca caattcccac cataatcgac tgaggatgat 27420
tcaccgtcat caacttcaga ctcagcgttg tagtcgtcat gagtctcaca agccttggac 27480
caagaagact catcatcgca agttgatgat ttatcatgat gcttctctga gccgtgtttg 27540
ctacctagag tcagctgagc ttagctaacg ctagctagtg tcagctgacg ttacgtaagg 27600
ctaactagcg tcacgtgacc ttacgtaacg ctacgtaggc tcagctgagc ttagctaacc 27660
ctagctagtg tcacgtgagc ttacgctact atagaaaatg tgttatatcg acatgaccag 27720

acaaaggggc aacagttaac aaaacaatta attctttcat ttgagattaa ggaaggtaag 27780
gtactaaaaa gattaaaaaa aatgagctta tctctttgtt tctgtaataa taatataagt 27840
gtgataaact tttaatataa taattgtaat taggttttct acagatgagc accactcaga 27900
gacaagataa gaagaaaaca atttgttaa acatgattat agaaactttt agttaagtct 27960
tgaagtatca atataacaaa aaaaagtaca cacgactatg acaataaacc cactaccgtc 28020
aggttatcat ttcgatgaaa tgttttgata tcattaaata taacagtcac aaaaaatcat 28080
ctaattataa caatataact tatacatata tttaactaaa aacttagagt ttttgtaatg 28140
attctaattg atgattagag tttatagaaa tacaattaaa taaaaaatat aattttaaaa 28200
aaacatagta aagtcaatga gatcctctct gacctcagtg atcatttagt catgtatgta 28260
caacaatcat tgttcatcac atgactgtaa aataaataag gataaacttg ggaatatata 28320
taatatattg tattaaataa aaaagggaaa tacaaatatc aattttagat tcccgagttg 28380
acacaactca ccatgcacgc tgccacctca gctcccagct ctcgtcacat gtctcatgtc 28440
agttaggtct ttggttttta gtctttgaca caactcgcca tgcatgttgc cacgtgagct 28500
cgttcctctt cccatgatct caccactggg catgcatgct gccacctcag ctggcacctc 28560
ttctctatat gtccctagag gccatgcaca gtgccacctc agcactcctc tcagaaccca 28620
tacgtacctg ccaatcggct tctctccata aatatctatt taaattataa ctaattattt 28680
catatactta attgatgacg tggatgcatt gccatcgttg tttaataatt gttaattacg 28740
acatgataaa taaaatgaaa gtaaaaagta cgaaagattt tccatttgtt gttgtataaa 28800
tagagaagtg agtgatgcat aatgcatgaa tgcatgaccg cgccaccatg actgttggat 28860
acgacgagga gatcccattc gagcaagtta gggctcataa caagccagac gacgcttggt 28920
gtgctattca cggacacgtg tacgacgtta ccaagttcgc ttcagttcac ccaggaggag 28980
atattatctt gctcgctgct ggaaaggaag ctactgtcct ctacgagacc taccatgtta 29040
gaggagtgtc tgacgctgtg ctcagaaagt acagaatagg aaagttgcca gacggacaag 29100
gaggagctaa cgagaaggag aagagaacct tgtctggatt gtcctctgct tcttactaca 29160
cctggaactc cgatttctac agagtgatga gggagagagt tgtggctaga ttgaaggaga 29220
gaggaaaggc tagaagagga ggatacgaac tctggatcaa ggctttcttg ctccttgttg 29280
gattctggtc ctctctttac tggatgtgca ccctcgatcc atctttcgga gctatcttgg 29340
ctgctatgtc tttgggagtg ttcgctgctt ttgttggaac ctgcatccaa cacgatggaa 29400
accacggagc tttcgctcaa tctagatggg ttaacaaggt ggcaggatgg actttggata 29460
tgatcggagc ttctggaatg acttgggagt tccaacacgt gttgggacac cacccataca 29520
ctaacttgat cgaggaggag aacggattgc aaaaggtgtc cggaaagaag atggatacca 29580
agttggctga tcaagagtct gatccagatg tgttctccac ctacccaatg atgagattgc 29640
acccttggca ccagaagagg tggtatcaca ggttccagca catctacgga cctttcatct 29700
tcggattcat gaccatcaac aaggtggtga ctcaagatgt tggagtggtg ttgagaaaga 29760
gactcttcca aatcgatgct gagtgcagat atgcttcccc aatgtacgtt gctaggttct 29820
ggattatgaa ggctttgacc gtgttgtata tggttgcttt gccttgttat atgcaaggac 29880
cttggcacgg attgaaactc ttcgctatcg ctcacttcac ttgcggagag gttttggcta 29940
ccatgttcat cgtgaaccac attatcgagg gagtgtctta cgcttctaag gatgctgtta 30000
agggaactat ggctccacca aagactatgc acggagtgac ccccaatgaac aacactagaa 30060
aggaggttga ggctgaggct tctaagtctg gagctgtggt taagtctgtg ccattggatg 30120
attgggctgc tgttcagtgc caaacctctg tgaactggtc tgttggatct tggtttttgga 30180
accacttctc tggaggactc aaccaccaaa tcgagcacca cctcttccca ggattgtctc 30240
acgagaccta ctaccacatc caagacgtgg ttcaatctac ctgtgctgag tacggagttc 30300
cataccaaca cgagccatct ttgtggactg cttactggaa gatgctcgaa caccttagac 30360
aattgggaaa cgaggagact cacgagtcat ggcagagagc tgcttgatta atgaactaag 30420
actcccaaaa ccaccttccc tgtgacagtt aaaccctgct tataccttttc ctcctaataa 30480
tgttcatctg tcacacaaac taaaataaat aaaatgggag caataaataa aatgggagct 30540
catatattta caccatttac actgtctatt attcaccatg ccaattatta cttcataatt 30600
ttaaaattat gtcattttta aaaattgctt aatgatggaa aggattatta taagttaaaa 30660
gtataacata gataaactaa ccacaaaaca aatcaatata aactaactta ctctcccatc 30720
taatttttat ttaaatttct ttacacttct cttccatttc tatttctaca acattattta 30780
acatttttat tgtatttttc ttactttcta actctattca tttcaaaaat caatatatgt 30840
ttatcaccac ctctctaaaa aaaactttac aatcattggt ccagaaaagt taaatcacga 30900
gatggtcatt ttagcattaa aacaacgatt cttgtatcac tatttttcag catgtagtcc 30960
attctcttca aacaaagaca gcggctatat aatcgttgtg ttatattcag tctaaaacaa 31020
ctagctagcc tcagctgacg ttacgtaacg ctaggtagcg tcacgtgacg ttagctaacg 31080
ctaggtagcg tcagctgagc ttacgtaagc gccacgggca ggacataggg actactacaa 31140
gcatagtatg cttcagacaa agagctagga aagaactctt gatggaggtt aagagaaaaa 31200
agtgctagag gggcatagta atcaaacttg tcaaaaccgt catcatgatg agggatgaca 31260
taatataaaa agttgactaa ggtcttggta gtactctttg attagtatta tatattggtg 31320
agaacatgag tcaagaggag acaagaaacc gaggaaccat agtttagcaa caagatggaa 31380
gttgcaaagt tgagctagcc gctcgattag ttacatctcc taagcagtac tacaaggaat 31440
ggtctctata ctttcatgtt tagcacatgg tagtgcggat tgacaagtta gaaacagtgc 31500
ttaggagaca aagagtcagt aaaggtattg aaagagtgaa gttgatgctc gacaggtcag 31560
gagaagtccc tccgccagat ggtgactacc aaggggttgg tatcagctga gacccaaata 31620
agattcttcg gttgaaccag tggttcgacc gagactctta gggtgggatt tcactgtaag 31680
atttgtgcat tttgttgaat ataaattgac aatttttttt atttaattat agattattta 31740
gaatgaatta catatttagt ttctaacaag gatagcaatg gatgggtatg ggtacaggtt 31800

aaacatatct attacccacc catctagtcg tcgggtttta cacgtaccca cccgtttaca 31860
taaaccagac cggaatttta aaccgtaccc gtccgttagc gggtttcaga tttacccgtt 31920
taatcgggta aaacctgatt actaaatata tattttttat ttgataaaca aaacaaaaat 31980
gttaatattt tcatattgga tgcaatttta agaaacacat attcataaat ttccatattt 32040
gtaggaaaat aaaaagaaaa atatattcaa gaacacaaat ttcaccgaca tgacttttat 32100
tacagagttg gaattagatc taacaattga aaaattaaaa ttaagataga atatgttgag 32160
gaacatgaca tagtataatg ctgggttacc cgtcgggtag gtatcgaggc ggatactact 32220
aaatccatcc cactcgctat ccgataatca ctggtttcgg gtatacccat tcccgtcaac 32280
aggccttttt aaccggataa tttcaactta tagtgaatga attttgaata aatagttaga 32340
ataccaaaat cctggattgc atttgcaatc aaattttgtg aaccgttaaa ttttgcatgt 32400
acttgggata gatataatag aaccgaattt tcattagttt aatttataac ttactttgtt 32460
caaagaaaaa aaatatctat ccaatttact tataataaaa aataatctat ccaagttact 32520
tattataatc aacttgtaaa aaggtaagaa tacaaatgtg gtagcgtacg tgtgattata 32580
tgtgacgaaa tgttatatct aacaaaagtc caaattccca tggtaaaaaa aatcaaaatg 32640
catggcaggc tgtttgtaac cttggaataa gatgttggcc aattctggag ccgccacgta 32700
cgcaagactc agggccacgt tctcttcatg caaggatagt agaacaccac tccacccacc 32760
tcctatatta gacctttgcc caaccctccc caactttccc atcccatcca caaagaaacc 32820
gacattttta tcataaatca gggtttcgtt tttgtttcat cgataaactc aaaggtgatg 32880
attttagggt cttgtgagtg tgcttttttg tttgattcta ctgtagggtt tatgttcttt 32940
agctcatagg ttttgtgtat ttcttagaaa tgtggcttct ttaatctctg ggtttgtgac 33000
tttttgtgtg gtttctgtgt ttttcatatc aaaaacctat tttttccgag ttttttttta 33060
caaattctta ctctcaagct tgaatacttc acatgcagtg ttcttttgta gattttagag 33120
ttaatgtgtt aaaaagtttg gatttttctt gcttatagag cttcttcact ttgattttgt 33180
gggttttttt gttttaaagg tgagattttt gatgaggttt ttgcttcaaa gatgtcacct 33240
ttctgggttt gtcttttgaa taaagctatg aactgtcaca tggctgacgc aattttgtta 33300
ctatgtcatg aaagctgacg tttttccgtg ttatacatgt ttgcttacac ttgcatgcgt 33360
caaaaaaatt ggggcttttt agttttagtc aaagatttta cttctctttt gggatttatg 33420
aaggaaagtt gcaaactttc tcaaatttta ccatttttgc tttgatgttt gtttagattg 33480
cgacagaaca aactcatata tgttgaaatt tttgcttggt tttgtatagg attgtgtctt 33540
ttgcttataa atgttgaaat ctgaactttt tttttgtttg gtttctttga gcaggagata 33600
aggcgcacca ccatggcttc tacatctgct gctcaagacg ctgctcctta cgagttccct 33660
tctctcactg agatcaagag ggctcttcct tctgagtgtt tcgaggcttc tgttcctctt 33720
tctctctact acaccgctag atctcttgct cttgctggat ctctcgctgt tgctctctct 33780
tacgctagag ctttgcctct tgttcaggct aacgctcttc ttgatgctac tctctgcact 33840
ggatacgttc ttctccaggg aatcgttttc tggggattct tcaccgttgg tcacgattgt 33900
ggacacggag ctttctctag atctcacgtg ctcaacttct ctgttggaac cctcatgcac 33960
tctatcatcc ttaccccttt cgagtcttgg aagctctctc acagacacca ccacaagaac 34020
accggaaaca tcgataagga cgagatcttc taccctcaaa gagaggctga ttctcaccct 34080
gtttctagac accttgtgat gtctcttgga tctgcttggt tcgcttacct tttcgctgga 34140
ttccctccta gaaccatgaa ccacttcaac ccttgggagg ctatgtatgt tagaagagtg 34200
gctgctgtga tcatctctct cggagttctt ttcgctttcg ctggactcta ctcttacctc 34260
accttcgttc ttggattcac cactatggct atctactact tcggacctct cttcatcttc 34320
gctaccatgc ttgttgttac cactttcctc caccacaacg atgaggagac accttggtac 34380
gctgattctg agtggactta cgtgaaggga aacctctctt ctgtggacag atcttacggt 34440
gctctcatcg acaaccttag ccacaacatc ggaactcacc agatccacca cctcttccct 34500
atcatccctc actacaagct caacgatgct actgctgctt tcgctaaggc tttccctgag 34560
cttgttagga aaaacgctgc tcctatcatc ccaactttct tcaggatggc tgctatgtac 34620
gctaagtacg gagttgttga cactgatgct aagaccttca ctctcaagga ggctaaggct 34680
gctgctaaga ctaagtcatc ttgatgatta atgaaggccg cagatatcag atctggtcga 34740
cctagaggat ccccggccgc aaagataata acaaaagcct actatataac gtacatgcaa 34800
gtattgtatg atattaatgt ttttacgtac gtgtaaacaa aaataattac gtttgtaacg 34860
tatggtgatg atgtggtgca ctaggtgtag gccttgtatt aataaaaaga agtttgttct 34920
atatagagtg gtttagtacg acgatttatt tactagtcgg attggaatag agaaccgaat 34980
tcttcaatcc ttgcttttga tcaagaattg aaaccgaatc aaatgtaaaa gttgatatat 35040
ttgaaaaacg tattgagctt atgaaaatgc taatactctc atctgtatgg aaaagtgact 35100
ttaaaaccga acttaaaagt gacaaaaggg gaatatcgca tcaaaccgaa tgaaaccgat 35160
ctacgtaggc tcagctgagc ttacctaagg ctacgtaggc tcacgtgacg ttacgtaagg 35220
ctacgtagcg tcacgtgagc ttacctaact ctagctagcc tcacgtgacc ttagctaaca 35280
ctaggtagcg tcagcttagc agatatttgg tgtctaaatg tttattttgt gatatgttca 35340
tgtttgaaat ggtggtttcg aaaccaggga caacgttggg atctgatagg gtgtcaaaga 35400
gtattatgga ttgggacaat ttcggtcatg agttgcaaat tcaagtatat cgttcgatta 35460
tgaaaatttt cgaagaatat cccatttgag agagtcttta cctcattaat gtttttagat 35520
tatgaaattt tatcatagtt catcgtagtc tttttggtgt aaaggctgta aaaagaaatt 35580
gttcactttt gttttcgttt atgtgaaggc tgtaaaagat tgtaaaagac tattttggtg 35640
ttttggataa aatgatagtt tttatagatt cttttgcttt tagaagaaat acatttgaaa 35700
ttttttccat gttgagtata aaataccgaa atcgattgaa gatcatagaa atattttaac 35760
tgaaaacaaa tttataactg attcaattct ctccattttt atacctattt aaccgtaatc 35820
gattctaata gatgatcgat tttttatata atcctaatta accaacggca tgtattggat 35880

aattaaccga tcaactctca cccctaatag aatcagtatt ttccttcgac gttaattgat 35940
cctacactat gtaggtcata tccatcgttt taatttttgg ccaccattca attctgtctt 36000
gcctttaggg atgtgaatat gaacggccaa ggtaagagaa taaaaataat ccaaattaaa 36060
gcaagagagg ccaagtaaga taatccaaat gtacacttgt cattgccaaa attagtaaaa 36120
tactcggcat attgtattcc cacacattat taaaataccg tatatgtatt ggctgcattt 36180
gcatgaataa tactacgtgt aagcccaaaa gaacccacgt gtagcccatg caaagttaac 36240
actcacgacc ccattcctca gtctccacta tataaaccca ccatccccaa tctcaccaaa 36300
cccaccacac aactcacaac tcactctcac accttaaaga accaatcacc accaaaaaaa 36360
gttctttgct ttcgaagttg ccgcaaccta aacaggtttt tccttcttct ttcttcttat 36420
taactacgac cttgtccttt gcctatgtaa aattactagg ttttcatcag ttacactgat 36480
taagttcgtt atagtggaag ataaaatgcc ctcaaagcat tttgcaggat atctttgatt 36540
tttcaaagat atggaactgt agagtttgat agtgttcttg aatgtggttg catgaagttt 36600
ttttggtctg catgttattt tttcctcgaa atatgttttg agtccaacaa gtgattcact 36660
tgggattcag aaagttgttt tctcaatatg taacagtttt tttctatgga gaaaaatcat 36720
agggaccgtt ggttttggct tctttaattt tgagctcaga ttaaacccat tttacccggt 36780
gttcttggca gaattgaaaa cagtacgtag taccgcgcct accatgccac ctagtgctgc 36840
tagtgaaggt ggtgttgctg aacttagagc tgctgaagtt gctagctaca ctagaaaggc 36900
tgttgacgaa agacctgacc tcactatagt tggtgacgct gtttacgacg ctaaggcttt 36960
tagggacgag caccctggtg gtgctcactt cgttagcctt ttcggaggta gggacgctac 37020
tgaggctttt atggaatatc accgtagagc ttggcctaag gctaggatgt ctaagttctt 37080
cgttggttca cttgacgcta gcgagaagcc tactcaagct gattcatctt accttagact 37140
ttgcgctgag gttaacgctc ttttgcctaa gggtagcgga ggattcgctc ctcctagcta 37200
ctggcttaag gctgctgctc ttgttgttgc tgctgttagt atagagggtt atatgctcct 37260
taggggtaag acccttttgc ttagcgtttt ccttggactc gtgttcgctt ggataggact 37320
taatattcag cacgacgcta atcacggtgc tcttagtaga cactcagtga ttaactactg 37380
cctcggttac gctcaggatt ggataggtgg taatatggtg ctttggcttc aagagcacgt 37440
tgtgatgcac cacctccaca ctaacgacgt tgacgctgat cctgatcaaa aggctcacgg 37500
tgttcttaga cttaagccta ctgacggttg gatgccttgg cacgcacttc aacaactcta 37560
tatccttcct ggtgaggcta tgtacgcttt taagcttctt ttcttggacg cccttgagct 37620
tcttgcttgg aggtgggagg gtgagaagat tagccctctt gctagagctt tgttcgctcc 37680
tgctgttgct tgtaagcttg gattctgggc tagattcgtt gctctccctc tctggcttca 37740
acctactgtt cacactgctt tgtgtatctg tgctactgtg tgtactggta gcttctacct 37800
cgccttcttc ttctttatct ctcacaactt cgacggtgtt ggtagcgttg gacctaaggg 37860
atcacttcct agatcagcta ctttcgttca acgtcaggtt gagactagct ctaacgttgg 37920
tggttactgg cttggagttc ttaacggtgg acttaacttt cagatagagc accacttgtt 37980
ccctaggctt caccactctt actacgctca aatagctcct gtggttagga ctcacataga 38040
gaagctcggt tttaagtacc gtcacttccc taccgttgga tctaacctta gctcaatgct 38100
tcagcatatg ggtaagatgg gaactagacc tggtgctgag aagggtggta aggctgagta 38160
gtgattaatg aataattgat tgctgcttta atgagatatg cgagacgcct atgatcgcat 38220
gatatttgct ttcaattctg ttgtgcacgt tgtaaaaaac ctgagcatgt gtagctcaga 38280
tccttaccgc cggtttcggt tcattctaat gaatatatca cccgttacta tcgtattttt 38340
atgaataata ttctccgttc aatttactga ttgtctacgt agcgtcacct gacgttacgt 38400
aaggctacct aggctcacgt gacgttacgt aacgctacgt agcgtcaggt gaggttagct 38460
aacgctagct agcctcacct gacgttaggt aaggctacgt agcgtcacct gagattagct 38520
aagcctacct agactcacgt gaccttaggt aacgctacgt agcgtcaaag ctttacaacg 38580
ctacacaaaa cttataaccg taatcaccat tcattaactt aactactatc acatgcattc 38640
atgaattgaa acgagaagga tgtaaatagt tgggaagtta tctccacgtt gaagagatcg 38700
ttagcgagag ctgaaagacc gagggaggag acgccgtcaa cacggacaga gtcgtcgacc 38760
ctcacatgaa gtaggaggaa tctccgtgag gagccagaga gacgtctttg gtcttcggtt 38820
tcgatccttg atctgacgga gaagacgaga gaagtgcgac tggactccgt gaggaccaac 38880
agagtcgtcc tcggtttcga tcgtcggtat tggtggagaa ggcggaggaa tctccgtgac 38940
gagccagaga gatgtcgtcg gtcttcggtt tcgatccttg atctgacgga gaagacgaga 39000
gaagtgcgac gagactccgt gaggaccaac agagttgtcc tcggtttcga tcgtcggttt 39060
cggcggagaa ggcggaggaa tctccgtgag gagccagaga gacgtcgttg gtcttcggtt 39120
tcgatccttg atctgttgga gaagacgaga caagtgggac gagactcaac gacggagtca 39180
gagacgtcgt cggtcttcgg tttcggccga gaaggcggag tcggtcttcg gtttcggccg 39240
agaaggcgga ggagacgtct tcgatttggg tctctcctct tgacgaagaa aacaaagaac 39300
acgagaaata atgagaaaga gaacaaaaga aaaaaaaata aaaataaaaa taaaatttgg 39360
tcctcttatg tggtgacacg tggtttgaaa cccaccaaat aatcgatcac aaaaaaccta 39420
agttaaggat cggtaataac ctttctaatt aattttgatt tatattaaat cactcttttt 39480
atttataaac cccactaaat tatgcgatat tgattgtcta agtacaaaaa ttctctcgaa 39540
ttcaatacac atgtttcata tatttagccc tgttcattta atattactag cgcattttta 39600
atttaaaatt ttgtaaactt ttttggtcaa agaacatttt tttaattaga gacagaaatc 39660
tagactcttt atttggaata atagtaataa agatatatta ggcaatgagt ttatgatgtt 39720
atgtttatat agtttatttc attttaaatt gaaaagcatt atttttatcg aaatgaatct 39780
agtatacaat caatatttat gttttttcat cagatacttt cctatttttt ggcacctttc 39840
atcggactac tgatttattt caatgtgtat gcatgcatga gcatgagtat acacatgtct 39900
tttaaaatgc atgtaaagcg taacggacca caaaagagga tccatacaaa tacatctcat 39960

```
cgcttcctct actattctcc gacacacaca ctgagcatgg tgcttaaaca ctctggtgag  40020
ttctagtact tctgctatga tcgatctcat taccatttct taaatttctc tccctaaata  40080
ttccgagttc ttgattttg ataacttcag gttttctctt tttgataaat ctggtctttc  40140
cattttttt tttttgtggt taatttagtt tcctatgttc ttcgattgta ttatgcatga  40200
tctgtgtttg gattctgtta gattatgtat tggtgaatat gtatgtgttt ttgcatgtct  40260
ggttttggtc ttaaaaatgt tcaaatctga tgatttgatt gaagcttttt tagtgttggt  40320
ttgattcttc tcaaaactac tgttaattta ctatcatgtt ttccaacttt gattcatgat  40380
gacacttttg ttctgctttg ttataaaatt ttggttggtt tgattttgta attatagtgt  40440
aattttgtta ggaatgaaca tgttttaata ctctgttttc gatttgtcac acattcgaat  40500
tattaatcga taatttaact gaaaattcat ggttctagat cttgttgtca tcagattatt  40560
tgtttcgata attcatcaaa tatgtagtcc ttttgctgat ttgcgactgt ttcatttttt  40620
ctcaaaattg ttttttgtta agtttatcta acagttatcg ttgtcaaaag tctctttcat  40680
tttgcaaaat cttctttttt tttttgtttg taactttgtt ttttaagcta cacatttagt  40740
ctgtaaaata gcatcgagga acagttgtct tagtagactt gcatgttctt gtaacttcta  40800
tttgtttcag tttgttgatg actgctttga ttttgtaggt caaaccgcgc catgtctgct  40860
agcggagctt tgttgcctgc tatagctttc gctgcttacg cttacgctac ctacgcttat  40920
gctttcgagt ggagccacgc taacggaatc gataacgtgg atgctagaga gtggattgga  40980
gctttgtctt tgagactccc tgcaattgca accacaatgt acctcttgtt ctgccttgtg  41040
ggacctagat tgatggctaa gagggaggct tttgatccta agggatttat gctcgcttac  41100
aacgcttacc aaaccgcttt caacgttgtg gtgctcggaa tgttcgctag agagatctct  41160
ggattgggac aacctgtttg gggatctact atgccttgga gcgataggaa gtccttcaag  41220
attttgttgg gagtgtggct ccactacaac aataagtacc tcgagttgtt ggatactgtg  41280
ttcatggtgg ctaggaaaaa gaccaagcag ctctctttct tgcacgtgta ccaccacgct  41340
ttgttgattt gggcttggtg gcttgtttgt cacctcatgg ctaccaacga ttgcatcgat  41400
gcttatttcg gagctgcttg caactctttc atccacatcg tgatgtactc ctactacctc  41460
atgtctgctt tgggaattag gtgcccttgg aagagatata tcacccaggc tcagatgttg  41520
caattcgtga tcgtgttcgc tcacgctgtt ttcgtgctca gacaaaagca ctgccctgtt  41580
actttgcctt gggcacaaat gttcgtgatg acaaatatgt tggtgctctt cggaaacttc  41640
tacctcaagg cttactctaa caagtctagg ggagatggag cttcttctgt taagcctgct  41700
gagactacta gagcaccttc tgtgagaaga accaggtcaa ggaagatcga ttgatagtta  41760
atgaactaag tttgatgtat ctgagtgcca acgtttactt tgtctttcct ttcttttatt  41820
ggttatgatt agatgtttac tatgttctct ctttttcgtt ataaataaag aagttcaatt  41880
cttctatagt ttcaaacgcg attttaagcg tttctattta ggtttacatg atttctttta  41940
caaaatcatc tttaaaatac agtatatttt tagttttcat aaaatattta aagaaatgaa  42000
agtttataaa cattcactcc tattctctaa ttaaggattt gtaaaacaaa aattttgtaa  42060
gcatatcgat ttatgcgttt tgtcttaatt agctcactaa ataataaata atagcttatg  42120
ttgtgggact gtttaattac ctaacttaga actaaaatca actctttgtg ctagctagcc  42180
tcagctgacg ttacgtaacg ctaggtagcg tcacgtgacg ttagctaacg ctaggtagcg  42240
tcagctgagc ttacgtaagc gcttaattaa agtactgata tcggtaccaa atcgaatcca  42300
aaaattacgg atatgaatat aggcatatcc gtatccgaat tatccgtttg acagctagca  42360
acgattgtac aattgcttct ttaaaaaagg aagaaagaaa gaaagaaaag aatcaacatc  42420
agcgttaaca aacggccccg ttacggccca aacggtcata tagagtaacg gcgttaagcg  42480
ttgaaagact cctatcgaaa tacgtaaccg caaacgtgtc atagtcagat cccctcttcc  42540
ttcaccgcct caaacacaaa aataatcttc tacagcctat atatacaacc ccccttcta  42600
tctctccttt ctcacaattc atcatctttc tttctctacc cccaatttta agaaatcctc  42660
tcttctcctc ttcattttca aggtaaatct ctctctctct ctctctctct gttattcctt  42720
gttttaatta ggtatgtatt attgctagtt tgttaatctg cttatcttat gtatgcctta  42780
tgtgaatatc tttatcttgt tcatctcatc cgtttagaag ctataaattt gttgatttga  42840
ctgtgtatct acacgtggtt atgtttatat ctaatcagat atgaatttct tcatattgtt  42900
gcgtttgtgt gtaccaatcc gaaatcgttg attttttca tttaatcgtg tagctaattg  42960
tacgtataca tatggatcta cgtatcaatt gttcatctgt ttgtgtttgt atgtatacag  43020
atctgaaaac atcacttctc tcatctgatt gtgttgttac atacatagat atagatctgt  43080
tatatcattt tttttattaa ttgtgtatat atatatgtgc atagatctgg attacatgat  43140
tgtgattatt tacatgattt tgttatttac gtatgtatat atgtagatct ggactttttg  43200
gagttgttga cttgattgta tttgtgtgtg tatatgtgtg ttctgatctt gatatgttat  43260
gtatgtgcag ctgaaccatg gcggcggcaa caacaacaac aacaacatct tcttcgatct  43320
ccttctccac caaaccatct ccttcctcct ccaaatcacc attaccaatc tccagattct  43380
ccctcccatt ctccctaaac cccaacaaat catcctcctc ctcccgccgc cgcggtatca  43440
aatccagctc tccctcctcc atctccgccg tgctcaacac aaccaccaat gtcacaacca  43500
ctccctctcc aaccaaacct accaaacccg aaacattcat ctcccgattc gctccagatc  43560
aaccccgcaa aggcgctgat atcctcgtcg aggctttaga acgtcaaggc gtagaaaccg  43620
tattcgctta ccctggaggt acatcaatgg agattcacca agccttaacc cgctcttcct  43680
caatccgtaa cgtccttcct cgtcacgaac aaggaggtgt attcgcagca gaaggatacg  43740
ctcgatcctc aggtaaacca ggtatctgta tagccacttc aggtcccgga gctacaaatc  43800
tcgttagcgg attagccgat gcgttgttag atagtgttcc tcttgtagca atcacaggac  43860
aagtccctcg tcgtatgatt ggtacagatg cgtttcaaga gactccgatt gttgaggtaa  43920
cgcgttcgat tacgaagcat aactatcttg tgatggatgt tgaagatatc ccaaggatta  43980
ttgaagaggc tttcttttta gctacttctg gtagacctgg acctgttttg gttgatgttc  44040
```

ctaaagatat tcaacaacag cttgcgattc ctaattggga acaggctatg agattacctg 44100
gttatatgtc taggatgcct aaacctccgg aagattctca tttggagcag attgttaggt 44160
tgatttctga gtctaagaag cctgtgttgt atgttggtgg tggttgtctt aattctagcg 44220
atgaattggg taggtttgtt gagcttacgg gcatccctgt tgcgagtacg ttgatggggc 44280
tgggatctta tccttgtgat gatgagttgt cgttacatat gcttggaatg catgggactg 44340
tgtatgcaaa ttacgctgtg gagcatagtg atttgttgtt ggcgtttggg gtaaggtttg 44400
atgatcgtgt cacgggtaaa cttgaggctt ttgctagtag ggctaagatt gttcatattg 44460
atattgactc ggctgagatt gggaagaata agactcctca tgtgtctgtg tgtggtgatg 44520
ttaagctggc tttgcaaggg atgaataagg ttcttgagaa ccgagcggag gagcttaaac 44580
ttgattttgg agtttggagg aatgagttga acgtacagaa acagaagttt ccgttgagct 44640
ttaagacgtt tggggaagct attcctccac agtatgcgat taaggtcctt gatgagttga 44700
ctgatggaaa agccataata agtactggtg tcgggcaaca tcaaatgtgg gcggcgcagt 44760
tctacaatta caagaaacca aggcagtggc tatcatcagg aggccttgga gctatgggat 44820
ttggacttcc tgctgcgatt ggagcgtctg ttgctaaccc tgatgcgata gttgtggata 44880
ttgacggaga tggaagtttt ataatgaatg tgcaagagct agccactatt cgtgtagaga 44940
atcttccagt gaaggtactt ttattaaaca accagcatct tggcatggtt atgcaatggg 45000
aagatcggtt ctacaaagct aaccgagctc acacatttct cggggacccg gctcaggagg 45060
acgagatatt cccgaacatg ttgctgtttg cagcagcttg cgggattcca gcggcgaggg 45120
tgacaaagaa agcagatctc cgagaagcta ttcagacaat gctggataca ccaggacctt 45180
acctgttgga tgtgatttgt ccgcaccaag aacatgtgtt gccgatgatc ccgaatggtg 45240
gcactttcaa cgatgtcata acggaaggag atggccggat taaatactga gagatgaaac 45300
cggtgattat cagaaccttt tatggtcttt gtatgcatat ggtaaaaaaa cttagtttgc 45360
aatttcctgt ttgttttggt aatttgagtt tcttttagtt gttgatctgc ctgcttttg 45420
gtttacgtca gactactact gctgttgttg tttggtttcc tttctttcat tttataaata 45480
aataatccgg ttcggtttac tccttgtgac tggctcagtt tggttattgc gaaatgcgaa 45540
tggtaaattg agtaattgaa attcgttatt agggttctaa gctgttttaa cagtcactgg 45600
gttaatatct ctcgaatctt gcatggaaaa tgctcttacc attggttttt aattgaaatg 45660
tgctcatatg ggccgtggtt tccaaattaa ataaaactac gatgtcatcg agaagtaaaa 45720
tcaactgtgt ccacattatc agttttgtgt atacgatgaa atagggtaat tcaaaatcta 45780
gcttgatatg ccttttggtt cattttaacc ttctgtaaac attttttcag attttgaaca 45840
agtaaatcca aaaaaaaaaa aaaaaatctc aactcaacac taaattattt taatgtataa 45900
aagatgctta aaacatttgg cttaaaagaa agaagctaaa aacatagaga actcttgtaa 45960
attgaagtat gaaaatatac tgaattgggt attatatgaa tttttctgat ttaggattca 46020
catgatccaa aaaggaaatc cagaagcact aatcagacat tggaagtagg attaatcagt 46080
gatcagtaac tattaaattc aattaaccgc ggacatctac atttttgaat tgaaaaaaaa 46140
ttggtaatta ctctttcttt ttctccatat tgaccatcat actcattgct gatccatgta 46200
gatttcccgg acatgaagcc atttacaatt gaatatatcc tcacatatga aatatatttt 46260
ttttttacaa attacaccta ttaaattata cttgatcggt catctgatat atttgaaaga 46320
accctatcag ccagctattc ataatttaca taaaagaaaa ttacgtgctt aaaatctctc 46380
taaaaaaaaa aaaagacaaa gacatcaaac tgatccatga aagtaaaatg gagtgtattt 46440
taattttatc ttcagaccaa tgttatcaat gtagcccata tattaatact aaaacaactt 46500
ctgcacaaac acacgaatca aagcctcgtg tttcatcgta gctttagcta aaatttccca 46560
aaagcaaatt caatagtatt ttactaggtc aaacccacaa gagaaaaaga aagtcaatcc 46620
caaggatcaa gaaatgagaa gtgagaggag aatgctttat tgggtttgct aataactaat 46680
aagacatgaa gcagactgaa aacatctggt tttgtccaaa aaagaaggaa gtcagattcc 46740
aaaactgcgc acctacattg tttaatactc actcacacat acattcatgt ttttactgtt 46800
tatacacagt caataattta tacacagctc catgttttaa tatttaccca tctctctttt 46860
gtagtctatc gtagactttc acttgtgtcc ccctcatgcg gcaacatcct cagcaacttg 46920
atttactata tacaataata caaatcataa gatatttgtt aggagctggt ttgtaaatta 46980
tttcgataca atactgaagc gaagggacca gcaatctttt tagctgatca gaacaatctt 47040
actaacgtgt gtctttgtaa gaaaatccaa cttttacttt ttcaggaggg agtgtagcgg 47100
attatgtata aataactcga agagtggtgc acaaagttca agtgtttgtg taaaatgttc 47160
gacaagacat tgactaaagc attccgaaca tgtcaacaaa actacaattc taaaattgca 47220
aaaagctgct aaacggtgga atagcattta acacgcattc tataccaaac atttttttc 47280
ttgaacacca aagaaaccaa acctaatgtc aaccatcgta tggaaactat agaactaaat 47340
caaactaaca aattcttatt gtatattctt aaaaacatcc ttataagaca gtttttccaa 47400
atgaatcttt agacttcatt gtactaatat gtttaaaata atataattat gtatttaatt 47460
tcttgaaagt ttcgctgcta agaggcaatt atctttttat attttttct ctcttatttt 47520
caaattctaa ttaattttct tggagagttt atccgatgat gatattctta tttcaactca 47580
atccacgagt aaatgtgtta gcaccacatc taaccatttg gagcttgtac tagctctatc 47640
tttccaaact taactttctt gagtgcttat ttatataaag catcagtata tggcccaacc 47700
caagaaaagc tgaacaaaat tagcaacaat agcaagggac gaactgcagc tcttcttggt 47760
tgtcgtgcct tccaattctc gactttccgt ggaagaacat 47800

<210> 290
<211> 43773
<212> DNA
<213> Artificial sequence

<220>
<223> T-DNA insertion in LBFLFK Locus 2, including left and right
 border sequences

<400> 290
ccagtcagca tcatcacacc aaaagttagg cccgaatagt ttgaaattag aaagctcgca 60
attgaggtct acaggccaaa ttcgctctta gccgtacaat attactcacc ggtgcgatgc 120
cccccatcgt aggtgaaggt ggaaattaat ggcgcgcctg atcactgatt agtaactatt 180
acgtaagcct acgtagcgtc acgtgacgtt agctaacgct acgtagcctc agctgacgtt 240
acgtaagcct acgtagcgtc acgtgagctt agctaacgct acctaggctc agctgacgtt 300
acgtaacgct agctagcgtc actcctgcag caaatttaca cattgccact aaacgtctaa 360
acccttgtaa tttgtttttg ttttactatg tgtgttatgt atttgatttg cgataaattt 420
ttatatttgg tactaaattt ataacacctt ttatgctaac gtttgccaac acttagcaat 480
ttgcaagttg attaattgat tctaaattat ttttgtcttc taaatacata tactaatcaa 540
ctggaaatgt aaatatttgc taatatttct actataggag aattaaagtg agtgaatatg 600
gtaccacaag gtttggagat ttaattgttg caatgctgca tggatggcat atacaccaaa 660
cattcaataa ttcttgagga taataatggt accacacaag atttgaggtg catgaacgtc 720
acgtggacaa aaggtttagt aatttttcaa gacaacaatg ttaccacaca caagttttga 780
ggtgcatgca tggatgccct gtggaaagtt taaaaatatt ttggaaatga tttgcatgga 840
agccatgtgt aaaaccatga catccacttg gaggatgcaa taatgaagaa aactacaaat 900
ttacatgcaa ctagttatgc atgtagtcta tataatgagg attttgcaat actttcattc 960
atacacactc actaagtttt acacgattat aatttcttca tagccagtac tgtttaagct 1020
tcactgtctc tgaatcggca aaggtaaacg tatcaattat tctacaaacc cttttatttt 1080
tcttttgaat taccgtcttc attggttata tgataacttg ataagtaaag cttcaataat 1140
tgaatttgat ctgtgttttt ttggccttaa tactaaatcc ttacataagc tttgttgctt 1200
ctcctcttgt gagttgagtg ttaagttgta ataatggttc actttcagct ttagaagaaa 1260
ccatggaagt tgttgagagg ttctacggag agttggatgg aaaggtttcc caaggagtga 1320
acgctttgtt gggatctttc ggagttgagt tgactgatac cccaactact aagggattgc 1380
cactcgttga ttctccaact ccaattgtgt tgggagtgtc tgtttacttg accatcgtga 1440
tcggaggatt gctttggatc aaggctagag atctcaagcc aagagcttct gagccattct 1500
tgttgcaagc tttggtgttg gtgcacaact tgttctgctt cgctttgtct ctttacatgt 1560
gcgtgggtat cgcttaccaa gctatcacct ggagatattc cttgtgggga aacgcttata 1620
acccaaagca caaggagatg gctatcctcg tttacctctt ctacatgtcc aagtacgtgg 1680
agttcatgga taccgtgatc atgatcctca agagatccac cagacagatt tctttcctcc 1740
acgtgtacca ccactcttct atctccctta tctggtgggc tattgctcac cacgctccag 1800
gaggagaggc ttattggagt gctgctctca actctggagt gcacgtgttg atgtacgctt 1860
actacttctt ggctgcttgc ttgagatctt ccccaaagct caagaacaag tacctcttct 1920
ggggaagata cctcacccaa ttccagatgt tccagttcat gctcaacttg gtgcaagctt 1980
actacgatat gaaaaccaac gctccatatc cacaatggct catcaagatc ctcttctact 2040
acatgatctc cctcttgttc ctcttcggaa acttctacgt gcaaaagtac atcaagccat 2100
ccgatggaaa gcaaaaggga gctaagaccg agtgatcgac aagctcgagt ttctccataa 2160
taatgtgtga gtagttccca gataagggaa ttagggttcc tatagggttt cgctcatgtg 2220
ttgagcatat aagaaaccct tagtatgtat ttgtatttgt aaaatacttc tatcaataaa 2280
atttctaatt cctaaaacca aaatccagta ctaaaatcca gatcccccga attaattcgg 2340
cgttaattca gctagctagc ctcagctgac gttacgtaac gctaggtagc gtcacgtgac 2400
gttagctaac gctaggtagc gtcagctgag cttacgtaag cgcttagcag atatttggtg 2460
tctaaatgtt tattttgtga tatgttcatg tttgaaatgg tggtttcgaa accagggaca 2520
acgttgggat ctgatagggt gtcaaagagt attatggatt gggacaattt cggtcatgag 2580
ttgcaaattc aagtatatcg ttcgattatg aaaattttcg aagaatatcc catttgagag 2640
agtctttacc tcattaatgt ttttagatta tgaaatttta tcatagttca tcgtagtctt 2700
tttggtgtaa aggctgtaaa aagaaattgt tcacttttgt tttcgtttat gtgaaggctg 2760
taaaagattg taaaagacta ttttggtgtt ttggataaaa tgatagtttt tatagattct 2820
tttgctttta gaagaaatac atttgaaatt ttttccatgt tgagtataaa ataccgaaat 2880
cgattgaaga tcatagaaat attttaactg aaaacaaatt tataactgat tcaattctct 2940
ccatttttat acctatttaa ccgtaatcga ttctaataga tgatcgattt tttatataat 3000
cctaattaac caacggcatg tattggataa ttaaccgatc aactctcacc cctaatagaa 3060
tcagtatttt ccttcgacgt taattgatcc tacactatgt aggtcatatc catcgtttta 3120
atttttggcc accattcaat tctgtcttgc ctttagggat gtgaatatga acggccaagg 3180
taagagaata aaaataatcc aaattaaagc aagagaggcc aagtaagata atccaaatgt 3240
acacttgtca ttgccaaaat tagtaaaata ctcggcatat tgtattccca cacattatta 3300
aaataccgta tatgtattgg ctgcatttgc atgaataata ctacgtgtaa gcccaaaaga 3360
acccacgtgt agcccatgca aagttaacac tcacgacccc attcctcagt ctccactata 3420
taaacccacc atccccaatc tcaccaaacc caccacacaa ctcacaactc actctcacac 3480
cttaaagaac caatcaccac caaaaaattt cacgatttgg aatttgattc ctgcgatcac 3540
aggtatgaca ggttagattt tgttttgtat agttgtatac atacttcttt gtgatgtttt 3600
gtttacttaa tcgaattttt ggagtgtttt aaggtctctc gtttagaaat cgtggaaaat 3660
atcactgtgt gtgtgttctt atgattcaca gtgtttatgg gtttcatgtt ctttgtttta 3720

tcattgaatg ggaagaaatt tcgttgggat acaaatttct catgttctta ctgatcgtta 3780
ttaggagttt ggggaaaaag gaagagtttt tttggttggt tcgagtgatt atgaggttat 3840
ttctgtattt gatttatgag ttaatggtcg ttttaatgtt gtagaccatg ggaaaaggat 3900
ctgagggaag atctgctgct agagagatga ctgctgaggc taacggagat aagagaaaga 3960
ccatcctcat tgagggagtg ttgtacgatg ctaccaactt caaacaccca ggaggttcca 4020
ttattaactt cctcaccgag ggagaagctg gagttgatgc tacccaagct tacagagagt 4080
tccatcagag atccggaaag gctgataagt acctcaagtc cctcccaaag ttggatgctt 4140
ctaaggtgga gtctaggttc tctgctaagg agcaggctag aagggacgct atgaccaggg 4200
attacgctgc tttcagagag gagttggttg ctgagggata cttcgatcca tctatcccac 4260
acatgatcta cagagtggtg gagattgtgg ctttgttcgc tttgtctttc tggttgatgt 4320
ctaaggcttc tccaacctct ttggttttgg gagtggtgat gaacggaatc gctcaaggaa 4380
gatgcggatg ggttatgcac gagatgggac acggatcttt cactggagtt atctggctcg 4440
atgataggat gtgcgagttc ttctacggag ttggatgtgg aatgtctgga cactactgga 4500
agaaccagca ctctaagcac cacgctgctc caaacagatt ggagcacgat gtggatttga 4560
acaccttgcc actcgttgct ttcaacgaga gagttgtgag gaaggttaag ccaggatctt 4620
tgttggcttt gtggctcaga gttcaggctt atttgttcgc tccagtgtct tgcttgttga 4680
tcggattggg atggaccttg tacttgcacc caagatatat gctcaggacc aagagacaca 4740
tggagtttgt gtggatcttc gctagatata tcggatggtt ctccttgatg ggagctttgg 4800
gatattctcc tggaacttct gtgggaatgt acctctgctc tttcggactt ggatgcatct 4860
acatcttcct ccaattcgct gtgtctcaca cccacttgcc agttaccaac ccagaggatc 4920
aattgcactg gcttgagtac gctgctgatc acaccgtgaa catctctacc aagtcttggt 4980
tggttacctg gtggatgtct aacctcaact tccaaatcga gcaccacttg ttcccaaccg 5040
ctccacaatt caggttcaag gagatctctc caagagttga ggctctcttc aagagacaca 5100
acctccctta ctacgatttg ccatacacct ctgctgtttc tactaccttc gctaacctct 5160
actctgttgg acactctgtt ggagctgata ccaagaagca ggattgactg ctttaatgag 5220
atatgcgaga cgcctatgat cgcatgatat ttgctttcaa ttctgttgtg cacgttgtaa 5280
aaaacctgag catgtgtagc tcagatcctt accgccggtt tcggttcatt ctaatgaata 5340
tatcacccgt tactatcgta tttttatgaa taatattctc cgttcaattt actgattgtc 5400
tacgtaggct cagctgagct tacctaaggc tacgtaggct cacgtgacgt tacgtaaggc 5460
tacgtagcgt cacgtgagct tacctaactc tagctagcct cacgtgacct tagctaacac 5520
taggtagcgt cagctcgacg gcccggactg tatccaactt ctgatctttg aatctctctg 5580
ttccaacatg ttctgaagga gttctaagac ttttcagaaa gcttgtaaca tgctttgtag 5640
actttctttg aattactctt gcaaactctg attgaaccta cgtgaaaact gctccagaag 5700
ttctaaccaa attccgtctt gggaaggccc aaaatttatt gagtacttca gtttcatgga 5760
cgtgtcttca aagatttata acttgaaatc ccatcatttt taagagaagt tctgttccgc 5820
aatgtcttag atctcattga aatctacaac tcttgtgtca gaagttcttc cagaatcaac 5880
ttgcatcatg gtgaaaatct ggccagaagt tctgaacttg tcatatttct taacagttag 5940
aaaaatttct aagtgtttag aattttgact tttccaaagc aaacttgact tttgactttc 6000
ttaataaaac aaacttcata ttctaacatg tcttgatgaa atgtgattct tgaaatttga 6060
tgttgatgca aaagtcaaag tttgactttt cagtgtgcaa ttgaccattt tgctcttgtg 6120
ccaattccaa acctaaattg atgtatcagt gctgcaaact tgatgtcatg gaagatctta 6180
tgagaaaatt cttgaagact gagaggaaaa attttgtagt acaacacaaa gaatcctgtt 6240
tttcatagtc ggactagaca cattaacata aaacaccact tcattcgaag agtgattgaa 6300
gaaggaaatg tgcagttacc tttctgcagt tcataagagc aacttacaga cacttttact 6360
aaaatactac aaagaggaag attttaacaa cttagagaag taatgggagt taaagagcaa 6420
cacattaagg gggagtgtta aaattaatgt gttgtaacca ccactacctt tagtaagtat 6480
tataagaaaa ttgtaatcat cacattataa ttattgtcct tatttaaaat tatgataaag 6540
ttgtatcatt aagattgaga aaaccaaata gtcctcgtct tgatttttga attattgttt 6600
tctatgttac ttttcttcaa gcctatataa aaactttgta atgctaaatt gtatgctgga 6660
aaaaaatgtg taatgaattg aatagaaatt atggtatttc aaagtccaaa atccatcaat 6720
agaaatttag tacaaaacgt aactcaaaaa tattctctta ttttaaattt tacaacaata 6780
taaaaatatt ctcttatttt aaattttaca ataatataat ttatcacctg tcacctttag 6840
aataccacca acaatattaa tacttagata ttttattctt aataattttg agatctctca 6900
atatatctga tatttatttt atatttgtgt catattttct tatgttttag agttaaccct 6960
tatatcttgg tcaaactagt aattcaatat atgagtttgt gaaggacaca ttgacatctt 7020
gaaacattgg ttttaacctt gttggaatgt taaaggtaat aaaacattca gaattatgac 7080
catctattaa tatacttcct ttgtctttta aaaaagtgtg catgaaaatg ctctatggta 7140
agctagagtg tcttgctggc ctgtgtatat caattccatt tccagatggt agaaactgcc 7200
actacgaata attagtcata agacacgtat gttaacacac gtccccttgc atgtttttttg 7260
ccatatattc cgtctctttc tttttcttca cgtataaaac aatgaactaa ttaatagagc 7320
gatcaagctg aacagttctt tgctttcgaa gttgccgcaa cctaaacagg tttttccttc 7380
ttctttcttc ttattaacta cgaccttgtc ctttgcctat gtaaaattac taggttttca 7440
tcagttacac tgattaagtt cgttatagtg gaagataaaa tgccctcaaa gcattttgca 7500
ggatatcttt gatttttcaa agatatggaa ctgtagagtt tgatagtgtt cttgaatgtg 7560
gttgcatgaa gtttttttgg tctgcatgtt attttttcct cgaaatatgt tttgagtcca 7620
acaagtgatt cacttgggat tcagaaagtt gttttctcaa tatgtaacag tttttttcta 7680
tggagaaaaa tcatagggac cgttggtttt ggcttcttta attttgagct cagattaaac 7740
ccattttacc cggtgttctt ggcagaattg aaaacagtac gtagtaccgc gcctaccatg 7800

tgtgttgaga ccgagaacaa cgatggaatc cctactgtgg agatcgcttt cgatggagag 7860
agagaaagag ctgaggctaa cgtgaagttg tctgctgaga agatggaacc tgctgctttg 7920
gctaagacct tcgctagaag atacgtggtt atcgagggag ttgagtacga tgtgaccgat 7980
ttcaaacatc ctggaggaac cgtgattttc tacgctctct ctaacactgg agctgatgct 8040
actgaggctt tcaaggagtt ccaccacaga tctagaaagg ctaggaaggc tttggctgct 8100
ttgccttcta gacctgctaa gaccgctaaa gtggatgatg ctgagatgct ccaggatttc 8160
gctaagtgga gaaaggagtt ggagagggac ggattcttca agccttctcc tgctcatgtt 8220
gcttacagat tcgctgagtt ggctgctatg tacgctttgg gaacctactt gatgtacgct 8280
agatacgttg tgtcctctgt gttggtttac gcttgcttct tcggagctag atgtggatgg 8340
gttcaacacg agggaggaca ctcttctttg accggaaaca tctggtggga taagagaatc 8400
caagctttca ctgctggatt cggattggct ggatctggag atatgtggaa ctccatgcac 8460
aacaagcacc acgctactcc tcaaaaagtg aggcacgata tggatttgga taccactcct 8520
gctgttgctt tcttcaacac cgctgtggag gataatagac ctaggggatt ctctaagtac 8580
tggctcagat tgcaagcttg gaccttcatt cctgtgactt ctggattggt gttgctcttc 8640
tggatgttct tcctccaccc ttctaaggct ttgaagggag gaaagtacga ggagcttgtg 8700
tggatgttgg ctgctcacgt gattagaacc tggaccatta aggctgttac tggattcacc 8760
gctatgcaat cctacggact cttcttggct acttcttggg tttccggatg ctacttgttc 8820
gctcacttct ctacttctca cacccacttg gatgttgttc ctgctgatga gcacttgtct 8880
tgggttaggt acgctgtgga tcacaccatt gatatcgatc cttctcaggg atgggttaac 8940
tggttgatgg gatacttgaa ctgccaagtg attcaccacc tcttcccttc tatgcctcaa 9000
ttcagacaac ctgaggtgtc cagaagattc gttgctttcg ctaagaagtg gaacctcaac 9060
tacaaggtga tgacttatgc tggagcttgg aaggctactt tgggaaacct cgataatgtg 9120
ggaaagcact actacgtgca cggacaacac tctggaaaga ccgcttgatt aatgaaggcc 9180
gcctcgaccg tacccctgc agatagacta tactatgttt tagcctgcct gctggctagc 9240
tactatgtta tgttatgttg taaaataaac acctgctaag gtatatctat ctatatttta 9300
gcatggcttt ctcaataaat tgtctttcct tatcgtttac tatcttatac ctaataatga 9360
aataataata tcacatatga ggaacggggc aggtttaggc atatatatac gagtgtaggg 9420
cggagtgggg ctacgtagcg tcacgtgacg ttacctaagc ctaggtagcc tcagctgacg 9480
ttacgtaacg ctaggtaggc tcagctgaca cgggcaggac atagggacta ctacaagcat 9540
agtatgcttc agacaaagag ctaggaaaga actcttgatg gaggttaaga gaaaaaagtg 9600
ctagaggggc atagtaatca aacttgtcaa aaccgtcatc atgatgaggg atgacataat 9660
ataaaaagtt gactaaggtc ttggtagtac tctttgatta gtattatata ttggtgagaa 9720
catgagtcaa gaggagacaa gaaaccgagg aaccatagtt tagcaacaag atggaagttg 9780
caaagttgag ctagccgctc gattagttac atctcctaag cagtactaca aggaatggtc 9840
tctatacttt catgtttagc acatggtagt gcggattgac aagttagaaa cagtgcttag 9900
gagacaaaga gtcagtaaag gtattgaaag agtgaagttg atgctcgaca ggtcaggaga 9960
agtccctccg ccagatggtg actaccaagg ggttggtatc agctgagacc caaataagat 10020
tcttcggttg aaccagtggt tcgaccgaga ctcttagggt gggatttcac tgtaagattt 10080
gtgcattttg ttgaatataa attgacaatt ttttttattt aattatagat tatttagaat 10140
gaattacata tttagtttct aacaaggata gcaatggatg ggtatgggta caggttaaac 10200
atatctatta cccacccatc tagtcgtcgg gttttacacg tacccacccg tttacataaa 10260
ccagaccgga attttaaacc gtacccgtcc gttagcgggt ttcagattta cccgtttaat 10320
cgggtaaaac ctgattacta aatatatatt ttttatttga taaacaaaac aaaaatgtta 10380
atattttcat attggatgca attttaagaa acacatattc ataaatttcc atatttgtag 10440
gaaaataaaa agaaaaatat attcaagaac acaaatttca ccgacatgac ttttattaca 10500
gagttggaat tagatctaac aattgaaaaa ttaaaattaa gatagaatat gttgaggaac 10560
atgacatagt ataatgctgg gttacccgtc gggtaggtat cgaggcggat actactaaat 10620
ccatcccact cgctatccga taatcactgg tttcgggtat acccattccc gtcaacaggc 10680
ctttttaacc ggataatttc aacttatagt gaatgaattt tgaataaata gttagaatac 10740
caaaatcctg gattgcattt gcaatcaaat tttgtgaacc gttaaatttt gcatgtactt 10800
gggatagata taatagaacc gaattttcat tagtttaatt tataacttac tttgttcaaa 10860
gaaaaaaaat atctatccaa tttacttata ataaaaaata atctatccaa gttacttatt 10920
ataatcaact tgtaaaaagg taagaataca aatgtggtag cgtacgtgtg attatatgtg 10980
acgaaatgtt atatctaaca aaagtccaaa ttcccatggt aaaaaaaatc aaaatgcatg 11040
gcaggctgtt tgtaaccttg gaataagatg ttggccaatt ctggagccgc cacgtacgca 11100
agactcaggg ccacgttctc ttcatgcaag gatagtagaa caccactcca cccacctcct 11160
atattagacc tttgcccaac cctccccaac tttcccatcc catccacaaa gaaaccgaca 11220
tttttatcat aaatctggtg cttaaacact ctggtgagtt ctagtacttc tgctatgatc 11280
gatctcatta ccatttctta aatttctctc cctaaatatt ccgagttctt gatttttgat 11340
aacttcaggt tttctctttt tgataaatct ggtctttcca tttttttttt ttgtggttaa 11400
tttagtttcc tatgttcttc gattgtatta tgcatgatct gtgtttggat tctgttagat 11460
tatgtattgg tgaatatgta tgtgtttttg catgtctggt tttggtctta aaaatgttca 11520
aatctgatga tttgattgaa gctttttag tgttggtttg attcttctca aaactactgt 11580
taatttacta tcatgttttc caactttgat tcatgatgac acttttgttc tgctttgtta 11640
taaaattttg gttggtttga ttttgtaatt atagtgtaat tttgttagga atgaacatgt 11700
tttaatactc tgttttcgat ttgtcacaca ttcgaattat taatcgataa tttaactgaa 11760
aattcatggt tctagatctt gttgtcatca gattatttgt ttcgataatt catcaaatat 11820
gtagtccttt tgctgatttg cgactgtttc attttttctc aaaattgttt tttgttaagt 11880

ttatctaaca gttatcgttg tcaaaagtct ctttcatttt gcaaaatctt cttttttttt 11940
ttgtttgtaa ctttgttttt taagctacac atttagtctg taaaatagca tcgaggaaca 12000
gttgtcttag tagacttgca tgttcttgta acttctattt gtttcagttt gttgatgact 12060
gctttgattt tgtaggtcaa aggcgcaccc taccatggat gcttataacg ctgctatgga 12120
taagattgga gctgctatca tcgattggag tgatccagat ggaaagttca gagctgatag 12180
ggaggattgg tggttgtgcg atttcagatc cgctatcacc attgctctca tctacatcgc 12240
tttcgtgatc ttgggatctg ctgtgatgca atctctccca gctatggacc catacccctat 12300
caagttcctc tacaacgtgt ctcaaatctt cctctgcgct tacatgactg ttgaggctgg 12360
attcctcgct tataggaacg gatacaccgt tatgccatgc aaccacttca acgtgaacga 12420
tccaccagtt gctaacttgc tctggctctt ctacatctcc aaagtgtggg atttctggga 12480
taccatcttc attgtgctcg gaaagaagtg gagacaactc tctttcttgc acgtgtacca 12540
ccacaccacc atcttcctct tctactggtt gaacgctaac gtgctctacg atggagatat 12600
cttcttgacc atcctcctca acggattcat tcacaccgtg atgtacacct actacttcat 12660
ctgcatgcac accaaggatt ctaagaccgg aaagtctttg ccaatctggt ggaagtcatc 12720
tttgaccgct ttccaactct tgcaattcac catcatgatg tcccaagcta cctacttggt 12780
tttccacgga tgcgataagg tttccctcag aatcaccatc gtgtacttcg tgtacattct 12840
ctccctttttc ttcctcttcg ctcagttctt cgtgcaatcc tacatggctc caaagaagaa 12900
gaagtccgct tgatgttaat gaaggccgca gatatcagat ctggtcgacc tagaggatcc 12960
ccggccgcaa agataataac aaaagcctac tatataacgt acatgcaagt attgtatgat 13020
attaatgttt ttacgtacgt gtaaacaaaa ataattacgt ttgtaacgta tggtgatgat 13080
gtggtgcact aggtgtaggc cttgtattaa taaaaagaag tttgttctat atagagtggt 13140
ttagtacgac gatttattta ctagtcggat tggaatagag aaccgaattc ttcaatcctt 13200
gcttttgatc aagaattgaa accgaatcaa atgtaaaagt tgatatattt gaaaaacgta 13260
ttgagcttat gaaaatgcta atactctcat ctgtatggaa aagtgacttt aaaaccgaac 13320
ttaaaagtga caaaaggga atatcgcatc aaaccgaatg aaaccgatct acgtaggctc 13380
agctgagctt agctaagcct acctagcctc acgtgagatt atgtaaggct aggtagcgtc 13440
acgtgacgtt acctaacact agctagcgtc agctgagctt agctaaccct acgtagcctc 13500
acgtgagctt acctaacgct acgtagcctc acgtgactaa ggatgaccta cccattcttg 13560
agacaaatgt tacattttag tatcagagta aaatgtgtac ctataactca aattcgattg 13620
acatgtatcc attcaacata aaattaaacc agcctgcacc tgcatccaca tttcaagtat 13680
tttcaaaccg ttcggctcct atccaccggg tgtaacaaga cggattccga atttggaaga 13740
ttttgactca aattcccaat ttatattgac cgtgactaaa tcaactttaa cttctataat 13800
tctgattaag ctcccaattt atattcccaa cggcactacc tccaaaattt atagactctc 13860
atcccctttt aaaccaactt agtaaacgtt tttttttaa ttttatgaag ttaagttttt 13920
accttgtttt taaaaagaat cgttcataag atgccatgcc agaacattag ctacacgtta 13980
cacatagcat gcagccgcgg agaattgttt ttcttcgcca cttgtcactc ccttcaaaca 14040
cctaagagct tctctctcac agcacacaca tacaatcaca tgcgtgcatg cattattaca 14100
cgtgatcgcc atgcaaatct cctttatagc ctataaatta actcatcggc ttcactcttt 14160
actcaaacca aaactcatca atacaaacaa gattaaaaac atttcacgat ttggaatttg 14220
attcctgcga tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt 14280
ctttgtgatg ttttgtttac ttaatcgaat tttggagtg ttttaaggtc tctcgtttag 14340
aaatcgtgga aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca 14400
tgttctttgt tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt 14460
cttactgatc gttattagga gtttggggaa aaaggaagag ttttttggt tggttcgagt 14520
gattatgagg ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac 14580
cgccatggct attttgaacc ctgaggctga ttctgctgct aacctcgcta ctgattctga 14640
ggctaagcaa agacaattgg ctgaggctgg atacactcac gttgagggtg ctcctgctcc 14700
tttgcctttg gagttgcctc acttctctct cagagatctc agagctgcta ttcctaagca 14760
ctgcttcgag agatctttcg tgacctccac ctactacatg atcaagaacg tgttgacttg 14820
cgctgctttg ttctacgctg ctaccttcat tgatagagct ggagctgctg cttatgtttt 14880
gtggcctgtg tactggttct tccagggatc ttacttgact ggagtgtggg ttatcgctca 14940
cgagtgtgga caccaggctt attgctcttc tgaggtggtg aacaacttga ttggactcgt 15000
gttgcactct gctttgttgg tgccttacca ctcttggaga atctctcaca gaaagcacca 15060
ctccaacact ggatcttgcg agaacgatga ggttttcgtt cctgtgacca gatctgtgtt 15120
ggcttcttct tggaacgaga ccttggagga ttctcctctc taccaactct accgtatcgt 15180
gtacatgttg gttgttggat ggatgcctgg atacctcttc ttcaacgcta ctggacctac 15240
taagtactgg ggaaagtcta ggtctcactt caacccttac tccgctatct atgctgatag 15300
ggagaggtgg atgatcgtgc tctccgatat tttcttggtg gctatgttgg ctgttttggc 15360
tgctttggtg cacactttct ccttcaacac gatggtgaag ttctacgtgg tgccttactt 15420
cattgtgaac gcttacttgg tgttgattac ctacctccaa cacaccgata cctacatccc 15480
tcacttcaga gagggagagt ggaattggtt gagaggagct ttgtgcactg tggatagatc 15540
atttggtcca ttcctcgatt ctgtggtgca tagaatcgtg gatacccacg tttgccacca 15600
tatcttctcc aagatgcctt tctatcactg cgaggaggct accaacgcta ttaagcctct 15660
cctcggaaag ttctacttga aggatactac tcctgttcct gttgctctct ggagatctta 15720
cacccactgc aagttcgttg aggatgatgg aaaggtggtg ttctacaaga acaagttata 15780
gttaatgaat aattgattgg ttcgagtatt atggcattgg gaaaactgtt tttcttgtac 15840
catttgttgt gcttgtaatt tactgtgttt tttattcggt tttcgctatc gaactgtgaa 15900
atggaaatgg atggagaaga gttaatgaat gatatggtcc ttttgttcat tctcaaatta 15960

atattatttg ttttttctct tatttgttgt gtgttgaatt tgaaattata agagatatgc 16020
aaacattttg ttttgagtaa aaatgtgtca aatcgtggcc tctaatgacc gaagttaata 16080
tgaggagtaa aacacttgta gttgtaccat tatgcttatt cactaggcaa caaatatatt 16140
ttcagaccta gaaaagctgc aaatgttact gaatacaagt atgtcctctt gtgttttaga 16200
catttatgaa ctttccttta tgtaattttc cagaatcctt gtcagattct aatcattgct 16260
ttataattat agttatactc atggatttgt agttgagtat gaaaatattt tttaatgcat 16320
tttatgactt gccaattgat tgacaacatg catcaatcta gctagcctca gctgacgtta 16380
cgtaacgcta ggtagcgtca cgtgacgtta gctaacgcta ggtagcgtca gctgagctta 16440
cgtaagcgca cagatgaata ctagctgttg ttcacagttc tagtgtctcc tcattacgtg 16500
aattcaagct acgatcacta tctcaactcc tacataaaca tcagaatgct acaaaactat 16560
gcacaaaaac aaaagctaca tctaatacgt gaatcaatta ctctcatcac aagaaagaag 16620
atttcaatca ccgtcgagaa ggaggattca gttaattgaa tcaaagttcc gatcaaactc 16680
gaagactggt gagcacgagg acgacgaaga agagtgtctc gaagatacaa caagcaagaa 16740
atctactgag tgacctcctg aagttattgg cgcgattgag agaatcaatc cgaattaatt 16800
tcggggaaaa agataaatta gatactaagc gatgggcttg ggctgggcta agaaacaggt 16860
ggcaattggg ctggaggacc ccgcgattca tagcttccga tagcccaaaa aaaaacggat 16920
aacatattta tcgggtattt gaatttcagt gaaataagat attttctttt tgttaggaaa 16980
attttagaaa ataatggaaa ttaaatagcg attatgttac aagatacgat cagcatcggg 17040
cagtgcaaaa tgctatagct tcccaagatt tgatcctttt gggttatctc ctaatgacaa 17100
ttagtttagg attttgaaac ttatattaat actattatcc gacaacactt gtttcagctt 17160
cttattttaa catttttttgt tttttctat tcttcttccc atcagcattt tctttttaaa 17220
aaattgaata ctttaacttt ttaaaaattt cacaatgatc agatgatatt atggaagatc 17280
tcaagagtta aatgtatcca tcttggggca ttaaaaccgg tgtacgggat gataaataca 17340
gactttatat catatgatag ctcagtaatt catatttatc acgttgctaa aaaaattata 17400
aggtactagt agtcaacaaa atcaattaaa gagaaagaaa gaaacgcatg tgaagagagt 17460
ttacaactgg aaaagtaaaa taaaaattaa cgcatgttga atgctgacat gtcagtatgt 17520
ccatgaatcc acgtatcaag cgccattcat cgatcgtctt cctctttcta aatgaaaaca 17580
acttcacaca tcacaacaaa caatacacac aagacccccct ctctctcgtt gtctctctgc 17640
cagcgaccaa atcgaagctt gagaagaaca agaaggggtc aaaccatggc ttctacatct 17700
gctgctcaag acgctgctcc ttacgagttc ccttctctca ctgagatcaa gagggctctt 17760
ccttctgagt gtttcgaggc ttctgttcct ctttctctct actacaccgc tagatctctt 17820
gctcttgctg gatctctcgc tgttgctctc tcttacgcta gagctttgcc tcttgttcag 17880
gctaacgctc ttcttgatgc tactctctgc actggatacg ttcttctcca gggaatcgtt 17940
ttctggggat tcttcaccgt tggtcacgat tgtggacacg gagctttctc tagatctcac 18000
gtgctcaact tctctgttgg aaccctcatg cactctatca tccttacccc tttcgagtct 18060
tggaagctct ctcacagaca ccaccacaag aacaccggaa acatcgataa ggacgagatc 18120
ttctaccctc aaagagaggc tgattctcac cctgtttcta gacaccttgt gatgtctctt 18180
ggatctgctt ggttcgctta ccttttcgct ggattccctc ctagaaccat gaaccacttc 18240
aacccttggg aggctatgta tgttagaaga gtggctgctg tgatcatctc tctcggagtt 18300
cttttcgctt tcgctggact ctactcttac ctcaccttcg ttcttggatt caccactatg 18360
gctatctact acttcggacc tctcttcatc ttcgctacca tgcttgttgt taccactttc 18420
ctccaccaca acgatgagga gacaccttgg tacgctgatt ctgagtggac ttacgtgaag 18480
ggaaacctct cttctgtgga cagatcttac ggtgctctca tcgacaacct tagccacaac 18540
atcggaactc accagatcca ccacctcttc cctatcatcc ctcactacaa gctcaacgat 18600
gctactgctg ctttcgctaa ggctttccct gagcttgtta ggaaaaacgc tgctcctatc 18660
atcccaactt tcttcaggat ggctgctatg tacgctaagt acggagttgt tgacactgat 18720
gctaagacct tcactctcaa ggaggctaag gctgctgcta agactaagtc atcttgatga 18780
ttaatgaata attgattgta catactatat tttttgttta ccttgtgtta gtttaatgtt 18840
cagtgtcctc tctttattgt ggcacgtctc tttgttgtat gttgtgtcta tacaaagttg 18900
aaataatgga aagaaaagga agagtgtaat ttgttttgtt ttaagtgttt ataaatatat 18960
atatataggt catttagata gttctaggtt tctataaaac tctctctctg gaagtagaat 19020
ctgtttttga gaggatccag ttgcctacta atctccccca aaacccttca agcttaacct 19080
tcctcttcac aacaacagag gaaacacatc tcttgagctc tgagttctct tctttgagca 19140
tgtctatcgc taaactcatc tgccttatag cttccctctt ctcttcatct ctctctctca 19200
ccatttcgct gtaaaactta ttctcctccc tcagcctctc tatctcttcc ttcagcatct 19260
cacaattccc accataatcg actgaggatg attcaccgtc atcaacttca gactcagcgt 19320
tgtagtcgtc atgagtctca caagccttgg accaagaaga ctcatcatcg caagttgatg 19380
atttatcatg atgcttctct gagccgtgtt tgctacgtag cgtcacgtga cgttacctaa 19440
gcctaggtag cctcagctga cgttacgtaa cgctaggtag gctcagctga ctgcagcaaa 19500
tttacacatt gccactaaac gtctaaaccc ttgtaatttg tttttgtttt actatgtgtg 19560
ttatgtattt gatttgcgat aaatttttat atttggtact aaatttataa caccttttat 19620
gctaacgttt gccaacactt agcaatttgc aagttgatta attgattcta aattattttt 19680
gtcttctaaa tacatatact aatcaactgg aaatgtaaat atttgctaat atttctacta 19740
taggagaatt aaagtgagtg aatatggtac cacaaggttt ggagatttaa ttgttgcaat 19800
gctgcatgga tggcatatac accaaacatt caataattct tgaggataat aatggtacca 19860
cacaagattt gaggtgcatg aacgtcacgt ggacaaaagg tttagtaatt tttcaagaca 19920
acaatgttac cacacacaag ttttgaggtg catgcatgga tgccctgtgg aaagtttaaa 19980
aatattttgg aaatgatttg catggaagcc atgtgtaaaa ccatgacatc cacttggagg 20040

atgcaataat gaagaaaact acaaatttac atgcaactag ttatgcatgt agtctatata 20100
atgaggattt tgcaatactt tcattcatac acactcacta agttttacac gattataatt 20160
tcttcatagc cagtactgtt taagcttcac tgtctctgaa tcggcaaagg taaacgtatc 20220
aattattcta caaacccttt tatttttctt ttgaattacc gtcttcattg gttatatgat 20280
aacttgataa gtaaagcttc aataattgaa tttgatctgt gtttttttgg ccttaatact 20340
aaatccttac ataagctttg ttgcttctcc tcttgtgagt tgagtgttaa gttgtaataa 20400
tggttcactt tcagctttag aagaaacgcg ccttccatgg ctacaaagga ggcttacgtt 20460
ttcccaactc tcaccgagat caagagatct ctcccaaagg attgcttcga ggcttctgtg 20520
cctttgtctc tctactacac tgtgagatgc ttggttattg ctgtggcttt gaccttcgga 20580
ttgaactacg ctagagcttt gccagaggtt gagtctttct gggctttgga tgctgctttg 20640
tgcactggat atatcctcct ccagggaatt gtgttctggg gattcttcac tgttggacac 20700
gatgctggac acggagcttt ctctagatac cacctcttga acttcgttgt gggaaccttc 20760
atgcactctc tcatcttgac cccattcgag tcttggaagt tgacccacag acaccaccac 20820
aagaacaccg gaaacatcga tagagatgag gtgttctacc cacagagaaa ggctgatgat 20880
cacccattgt ccaggaactt gatcttggct ttgggagctg cttggcttgc ttatttggtg 20940
gagggattcc caccaagaaa ggtgaaccac ttcaacccat tcgagccact ttttgtgaga 21000
caagtgtccg ctgtggttat ctctttgctc gctcacttct tcgttgctgg actctctatc 21060
tacttgtctc tccagttggg acttaagacc atggctatct actactacgg accagttttc 21120
gtgttcggat ctatgttggt gattaccacc ttcttgcacc acaacgatga ggagactcca 21180
tggtatgctg attctgagtg gacttacgtg aagggaaact tgtcctctgt ggatagatct 21240
tacggtgctc tcatcgataa cctctcccac aacatcggaa ctcaccagat ccaccacctc 21300
ttcccaatta tcccacacta caagctcaag aaggctactg ctgctttcca ccaagctttc 21360
ccagagcttg tgagaaagtc cgatgagcca atcatcaagg ctttcttcag agtgggaagg 21420
ttgtatgcta actacggagt ggttgatcaa gaggctaagc tcttcacttt gaaggaggct 21480
aaggctgcta ctgaagctgc tgctaagacc aagtctacct gattaatgaa tcgacaagct 21540
cgagtttctc cataataatg tgtgagtagt tcccagataa gggaattagg gttcctatag 21600
ggtttcgctc atgtgttgag catataagaa acccttagta tgtatttgta tttgtaaaat 21660
acttctatca ataaaatttc taattcctaa aaccaaaatc cagtactaaa atccagatcc 21720
cccgaattaa ttcggcgtta attcagctac gtaggctcag ctgagcttac ctaaggctac 21780
gtaggctcac gtgacgttac gtaaggctac gtagcgtcac gtgagcttac ctaactctag 21840
ctagcctcac gtgaccttag ctaacactag gtagcgtcag cacagatgaa tactagctgt 21900
tgttcacagt tctagtgtct cctcattacg tgaattcaag ctacgatcac tatctcaact 21960
cctacataaa catcagaatg ctacaaaact atgcacaaaa acaaaagcta catctaatac 22020
gtgaatcaat tactctcatc acaagaaaga agatttcaat caccgtcgag aaggaggatt 22080
cagttaattg aatcaaagtt ccgatcaaac tcgaagactg gtgagcacga ggacgacgaa 22140
gaagagtgtc tcgaagatac aacaagcaag aaatctactg agtgacctcc tgaagttatt 22200
ggcgcgattg agagaatcaa tccgaattaa tttcggggaa aaagataaat tagatactaa 22260
gcgatgggct tgggctgggc taagaaacag gtggcaattg ggctggagga ccccgcgatt 22320
catagcttcc gatagcccaa aaaaaaacgg ataacatatt tatcgggtat ttgaatttca 22380
gtgaaataag atattttctt tttgttagga aaattttaga aaataatgga aattaaatag 22440
cgattatgtt acaagatacg atcagcatcg ggcagtgcaa aatgctatag cttcccaaga 22500
tttgatcctt ttgggttatc tcctaatgac aattagttta ggattttgaa acttatatta 22560
atactattat ccgacaacac ttgtttcagc ttcttatttt aacatttttt gtttttttct 22620
attcttcttc ccatcagcat tttcttttta aaaaattgaa tactttaact ttttaaaaat 22680
ttcacaatga tcagatgata ttatggaaga tctcaagagt taaatgtatc catcttgggg 22740
cattaaaacc ggtgtacggg atgataaata cagactttat atcatatgat agctcagtaa 22800
ttcatattta tcacgttgct aaaaaaatta taaggtacta gtagtcaaca aaatcaatta 22860
aagagaaaga aagaaacgca tgtgaagaga gtttacaact ggaaaagtaa aataaaaatt 22920
aacgcatgtt gaatgctgac atgtcagtat gtccatgaat ccacgtatca agcgccattc 22980
atcgatcgtc ttcctctttc taaatgaaaa caacttcaca catcacaaca aacaatacac 23040
acaagacccc ctctctctcg ttgtctctct gccagcgacc aaatcgaagc ttgagaagaa 23100
caagaagggg tcaaaccatg ggaaaaggat ctgagggaag atctgctgct agagagatga 23160
ctgctgaggc taacggagat aagagaaaga ccatcctcat tgagggagtg ttgtacgatg 23220
ctaccaactt caaacaccca ggaggttcca ttattaactt cctcaccgag ggagaagctg 23280
gagttgatgc tacccaagct tacagagagt tccatcagag atccggaaag gctgataagt 23340
acctcaagtc cctcccaaag ttggatgctt ctaaggtgga gtctaggttc tctgctaagg 23400
agcaggctag aagggacgct atgaccaggg attacgctgc tttcagagag gagttggttg 23460
ctgagggata cttcgatcca tctatcccac acatgatcta cagagtggtg gagattgtgg 23520
ctttgttcgc tttgtctttc tggttgatgt ctaaggcttc tccaacctct ttggttttgg 23580
gagtggtgat gaacggaatc gctcaaggaa gatgcggatg ggttatgcac gagatgggac 23640
acggatcttt cactggagtt atctggctcg atgataggat gtgcgagttc ttctacggag 23700
ttggatgtgg aatgtctgga cactactgga agaaccagca ctctaagcac cacgctgctc 23760
caaacagatt ggagcacgat gtggatttga acaccttgcc actcgttgct ttcaacgaga 23820
gagttgtgag gaaggttaag ccaggatctt tgttggcttt gtggctcaga gttcaggctt 23880
atttgttcgc tccagtgtct tgcttgttga tcggattggg atggaccttg tacttgcacc 23940
caagatatat gctcaggacc aagagacaca tggagtttgt gtggatcttc gctagatata 24000
tcggatggtt ctccttgatg ggagctttgg gatattctcc tggaacttct gtgggaatgt 24060
acctctgctc tttcggactt ggatgcatct acatcttcct ccaattcgct gtgtctcaca 24120

cccacttgcc agttaccaac ccagaggatc aattgcactg gcttgagtac gctgctgatc 24180
acaccgtgaa catctctacc aagtcttggt tggttacctg gtggatgtct aacctcaact 24240
tccaaatcga gcaccacttg ttcccaaccg ctccacaatt caggttcaag gagatctctc 24300
caagagttga ggctctcttc aagagacaca acctccctta ctacgatttg ccatacacct 24360
ctgctgtttc tactaccttc gctaacctct actctgttgg acactctgtt ggagctgata 24420
ccaagaagca ggattgatga ttaatgaata attgattgta catactatat tttttgttta 24480
ccttgtgtta gtttaatgtt cagtgtcctc tctttattgt ggcacgtctc tttgttgtat 24540
gttgtgtcta tacaaagttg aaataatgga aagaaaagga agagtgtaat ttgttttgtt 24600
ttaagtgttt ataaatatat atatataggt catttagata gttctaggtt tctataaaac 24660
tctctctctg gaagtagaat ctgtttttga gaggatccag ttgcctacta atctccccca 24720
aaacccttca agcttaacct tcctcttcac aacaacagag gaaacacatc tcttgagctc 24780
tgagttctct tctttgagca tgtctatcgc taaactcatc tgccttatag cttccctctt 24840
ctcttcatct ctctctctca ccatttcgct gtaaaactta ttctcctccc tcagcctctc 24900
tatctcttcc ttcagcatct cacaattccc accataatcg actgaggatg attcaccgtc 24960
atcaacttca gactcagcgt tgtagtcgtc atgagtctca caagccttgg accaagaaga 25020
ctcatcatcg caagttgatg atttatcatg atgcttctct gagccgtgtt tgctacctag 25080
agtcagctga gcttagctaa cgctagctag tgtcagctga cgttacgtaa ggctaactag 25140
cgtcacgtga ccttacgtaa cgctacgtag gctcagctga gcttagctaa ccctagctag 25200
tgtcacgtga gcttacgcta ctatagaaaa tgtgttatat cgacatgacc agacaaaggg 25260
gcaacagtta acaaaacaat taattctttc atttgagatt aaggaaggta aggtactaaa 25320
aagattaaaa aaaatgagct tatctctttg tttctgtaat aataatataa gtgtgataaa 25380
cttttaatat aataattgta attaggtttt ctacagatga gcaccactca gagacaagat 25440
aagaagaaaa caattttgtt aaacatgatt atagaaactt ttagttaagt cttgaagtat 25500
caatataaca aaaaaaagta cacacgacta tgacaataaa cccactaccg tcaggttatc 25560
atttcgatga aatgttttga tatcattaaa tataacagtc acaaaaaatc atctaattat 25620
aacaatataa cttatacata tatttaacta aaaacttaga gtttttgtaa tgattctaat 25680
tgatgattag agtttataga aatacaatta aataaaaaat ataattttaa aaaaacatag 25740
taaagtcaat gagatcctct ctgacctcag tgatcattta gtcatgtatg tacaacaatc 25800
attgttcatc acatgactgt aaaataaata aggataaact tgggaatata tataatatat 25860
tgtattaaat aaaaaaggga aatacaaata tcaattttag attcccgagt tgacacaact 25920
caccatgcac gctgccacct cagctcccag ctctcgtcac atgtctcatg tcagttaggt 25980
ctttggtttt tagtctttga cacaactcgc catgcatgtt gccacgtgag ctcgttcctc 26040
ttcccatgat ctcaccactg ggcatgcatg ctgccacctc agctggcacc tcttctctat 26100
atgtccctag aggccatgca cagtgccacc tcagcactcc tctcagaacc catacgtacc 26160
tgccaatcgg cttctctcca taaatatcta tttaaattat aactaattat ttcatatact 26220
taattgatga cgtggatgca ttgccatcgt tgtttaataa ttgttaatta cgacatgata 26280
aataaaatga aagtaaaaag tacgaaagat tttccatttg ttgttgtata aatagagaag 26340
tgagtgatgc ataatgcatg aatgcatgac cgcgccacca tgactgttgg atacgacgag 26400
gagatcccat tcgagcaagt tagggctcat aacaagccag acgacgcttg gtgtgctatt 26460
cacggacacg tgtacgacgt taccaagttc gcttcagttc acccaggagg agatattatc 26520
ttgctcgctg ctggaaagga agctactgtc ctctacgaga cctaccatgt tagaggagtg 26580
tctgacgctg tgctcagaaa gtacagaata ggaaagttgc cagacggaca aggaggagct 26640
aacgagaagg agaagagaac cttgtctgga ttgtcctctg cttcttacta cacctggaac 26700
tccgatttct acagagtgat gagggagaga gttgtggcta gattgaagga gagaggaaag 26760
gctagaagag gaggatacga actctggatc aaggctttct tgctccttgt tggattctgg 26820
tcctctcttt actggatgtg caccctcgat ccatctttcg gagctatctt ggctgctatg 26880
tctttgggag tgttcgctgc ttttgttgga acctgcatcc aacacgatgg aaaccacgga 26940
gctttcgctc aatctagatg ggttaacaag gtggcaggat ggactttgga tatgatcgga 27000
gcttctggaa tgacttggga gttccaacac gtgttgggac accacccata cactaacttg 27060
atcgaggagg agaacggatt gcaaaaggtg tccggaaaga agatggatac caagttggct 27120
gatcaagagt ctgatccaga tgtgttctcc acctacccaa tgatgagatt gcacccttgg 27180
caccagaaga ggtggtatca caggttccag cacatctacg gacctttcat cttcggattc 27240
atgaccatca acaaggtggt gactcaagat gttggagtgg tgttgagaaa gagactcttc 27300
caaatcgatg ctgagtgcag atatgcttcc ccaatgtacg ttgctaggtt ctggattatg 27360
aaggctttga ccgtgttgta tatggttgct ttgccttgtt atatgcaagg accttggcac 27420
ggattgaaac tcttcgctat cgctcacttc acttgcggag aggttttggc taccatgttc 27480
atcgtgaacc acattatcga gggagtgtct tacgcttcta aggatgctgt taagggaact 27540
atggctccac caaagactat gcacggagtg accccaatga acaacactag aaaggaggtt 27600
gaggctgagg cttctaagtc tggagctgtg gttaagtctg tgccattgga tgattgggct 27660
gctgttcagt gccaaacctc tgtgaactgg tctgttggat cttggttttg gaaccacttc 27720
tctggaggac tcaaccacca aatcgagcac cacctcttcc caggattgtc tcacgagacc 27780
tactaccaca tccaagacgt ggttcaatct acctgtgctg agtacggagt tccataccaa 27840
cacgagccat ctttgtggac tgcttactgg aagatgctcg aacaccttag acaattggga 27900
aacgaggaga ctcacgagtc atggcagaga gctgcttgat taatgaacta agactcccaa 27960
aaccaccttc cctgtgacag ttaaaccctg cttatacctt tcctcctaat aatgttcatc 28020
tgtcacacaa actaaaataa ataaaatggg agcaataaat aaaatgggag ctcatatatt 28080
tacaccattt acactgtcta ttattcacca tgccaattat tacttcataa ttttaaaatt 28140
atgtcatttt taaaaattgc ttaatgatgg aaaggattat tataagttaa aagtataaca 28200

tagataaact aaccacaaaa caaatcaata taaactaact tactctccca tctaattttt 28260
atttaaattt ctttacactt ctcttccatt tctatttcta caacattatt taacattttt 28320
attgtatttt tcttactttc taactctatt catttcaaaa atcaatatat gtttatcacc 28380
acctctctaa aaaaaacttt acaatcattg gtccagaaaa gttaaatcac gagatggtca 28440
ttttagcatt aaaacaacga ttcttgtatc actatttttc agcatgtagt ccattctctt 28500
caaacaaaga cagcggctat ataatcgttg tgttatattc agtctaaaac aactagctag 28560
cctcagctga cgttacgtaa cgctaggtag cgtcacgtga cgttagctaa cgctaggtag 28620
cgtcagctga gcttacgtaa gcgccacggg caggacatag ggactactac aagcatagta 28680
tgcttcagac aaagagctag gaaagaactc ttgatggagg ttaagagaaa aaagtgctag 28740
aggggcatag taatcaaact tgtcaaaacc gtcatcatga tgagggatga cataatataa 28800
aaagttgact aaggtcttgg tagtactctt tgattagtat tatatattgg tgagaacatg 28860
agtcaagagg agacaagaaa ccgaggaacc atagtttagc aacaagatgg aagttgcaaa 28920
gttgagctag ccgctcgatt agttacatct cctaagcagt actacaagga atggtctcta 28980
tactttcatg tttagcacat ggtagtgcgg attgacaagt tagaaacagt gcttaggaga 29040
caaagagtca gtaaaggtat tgaaagagtg aagttgatgc tcgacaggtc aggagaagtc 29100
cctccgccag atggtgacta ccaaggggtt ggtatcagct gagacccaaa taagattctt 29160
cggttgaacc agtggttcga ccgagactct tagggtggga tttcactgta agatttgtgc 29220
attttgttga atataaattg acaatttttt ttatttaatt atagattatt tagaatgaat 29280
tacatattta gtttctaaca aggatagcaa tggatgggta tgggtacagg ttaaacatat 29340
ctattaccca cccatctagt cgtcgggttt tacacgtacc cacccgttta cataaaccag 29400
accggaattt taaaccgtac ccgtccgtta gcgggtttca gatttacccg tttaatcggg 29460
taaaacctga ttactaaata tatatttttt atttgataaa caaaacaaaa atgttaatat 29520
tttcatattg gatgcaattt taagaaacac atattcataa atttccatat ttgtaggaaa 29580
ataaaaagaa aaatatattc aagaacacaa atttcaccga catgactttt attacagagt 29640
tggaattaga tctaacaatt gaaaaattaa aattaagata gaatatgttg aggaacatga 29700
catagtataa tgctgggtta cccgtcgggt aggtatcgag gcggatacta ctaaatccat 29760
cccactcgct atccgataat cactggtttc gggtataccc attcccgtca acaggccttt 29820
ttaaccggat aatttcaact tatagtgaat gaattttgaa taaatagtta gaataccaaa 29880
atcctggatt gcatttgcaa tcaaattttg tgaaccgtta aattttgcat gtacttggga 29940
tagatataat agaaccgaat tttcattagt ttaatttata acttactttg ttcaaagaaa 30000
aaaaatatct atccaattta cttataataa aaaataatct atccaagtta cttattataa 30060
tcaacttgta aaaaggtaag aatacaaatg tggtagcgta cgtgtgatta tatgtgacga 30120
aatgttatat ctaacaaaag tccaaattcc catggtaaaa aaaatcaaaa tgcatggcag 30180
gctgtttgta accttggaat aagatgttgg ccaattctgg agccgccacg tacgcaagac 30240
tcagggccac gttctcttca tgcaaggata gtagaacacc actccaccca cctcctatat 30300
tagacctttg cccaaccctc cccaactttc ccatcccatc cacaaagaaa ccgacatttt 30360
tatcataaat cagggtttcg tttttgtttc atcgataaac tcaaaggtga tgattttagg 30420
gtcttgtgag tgtgcttttt tgtttgattc tactgtaggg tttatgttct ttagctcata 30480
ggttttgtgt atttcttaga aatgtggctt ctttaatctc tgggtttgtg actttttgtg 30540
tggtttctgt gtttttcata tcaaaaacct attttttccg agtttttttt tacaaattct 30600
tactctcaag cttgaatact tcacatgcag tgttcttttg tagattttag agttaatgtg 30660
ttaaaaagtt tggatttttc ttgcttatag agcttcttca ctttgatttt gtgggttttt 30720
ttgttttaaa ggtgagattt ttgatgaggt ttttgcttca aagatgtcac ctttctgggt 30780
ttgtcttttg aataaagcta tgaactgtca catggctgac gcaattttgt tactatgtca 30840
tgaaagctga cgtttttccg tgttatacat gtttgcttac acttgcatgc gtcaaaaaaa 30900
ttggggcttt ttagttttag tcaaagattt tacttctctt ttgggattta tgaaggaaag 30960
ttgcaaactt tctcaaattt taccattttt gctttgatgt ttgtttagat tgcgacagaa 31020
caaactcata tatgttgaaa tttttgcttg gttttgtata ggattgtgtc ttttgcttat 31080
aaatgttgaa atctgaactt ttttttgtt tggtttcttt gagcaggaga taaggcgcac 31140
caccatggct tctacatctg ctgctcaaga cgctgctcct tacgagttcc cttctctcac 31200
tgagatcaag agggctcttc cttctgagtg tttcgaggct tctgttcctc tttctctcta 31260
ctacaccgct agatctcttg ctcttgctgg atctctcgct gttgctctct cttacgctag 31320
agctttgcct cttgttcagg ctaacgctct tcttgatgct actctctgca ctggatacgt 31380
tcttctccag ggaatcgttt tctggggatt cttcaccgtt ggtcacgatt gtggacacgg 31440
agctttctct agatctcacg tgctcaactt ctctgttgga accctcatgc actctatcat 31500
ccttacccct ttcgagtctt ggaagctctc tcacagacac caccacaaga acaccggaaa 31560
catcgataag gacgagatct tctaccctca aagagaggct gattctcacc ctgtttctag 31620
acacccttgtg atgtctcttg gatctgcttg gttcgcttac cttttcgctg gattccctcc 31680
tagaaccatg aaccacttca acccttggga ggctatgtat gttagaagag tggctgctgt 31740
gatcatctct ctcggagttc ttttcgcttt cgctggactc tactcttacc tcaccttcgt 31800
tcttggattc accactatgg ctatctacta cttcggacct ctcttcatct tcgctaccat 31860
gcttgttgtt accactttcc tccaccacaa cgatgaggag acaccttggt acgctgattc 31920
tgagtggact tacgtgaagg gaaacctctc ttctgtggac agatcttacg gtgctctcat 31980
cgacaacctt agccacaaca tcggaactca ccagatccac cacctcttcc ctatcatccc 32040
tcactacaag ctcaacgatg ctactgctgc tttcgctaag gctttccctg agcttgttag 32100
gaaaaacgct gctcctatca tcccaacttt cttcaggatg gctgctatgt acgctaagta 32160
cggagttgtt gacactgatg ctaagacctt cactctcaag gaggctaagg ctgctgctaa 32220
gactaagtca tcttgatgat taatgaaggc cgcagatatc agatctggtc gacctagagg 32280

atccccggcc gcaaagataa taacaaaagc ctactatata acgtacatgc aagtattgta 32340
tgatattaat gtttttacgt acgtgtaaac aaaaataatt acgtttgtaa cgtatggtga 32400
tgatgtggtg cactaggtgt aggccttgta ttaataaaaa gaagtttgtt ctatatagag 32460
tggtttagta cgacgattta tttactagtc ggattggaat agagaaccga attcttcaat 32520
ccttgctttt gatcaagaat tgaaaccgaa tcaaatgtaa aagttgatat atttgaaaaa 32580
cgtattgagc ttatgaaaat gctaatactc tcatctgtat ggaaaagtga ctttaaaacc 32640
gaacttaaaa gtgacaaaag gggaatatcg catcaaaccg aatgaaaccg atctacgtag 32700
gctcagctga gcttacctaa ggctacgtag gctcacgtga cgttacgtaa ggctacgtag 32760
cgtcacgtga gcttacctaa ctctagctag cctcacgtga ccttagctaa cactaggtag 32820
cgtcagctta gcagatattt ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa 32880
atggtggttt cgaaaccagg gacaacgttg ggatctgata gggtgtcaaa gagtattatg 32940
gattgggaca atttcggtca tgagttgcaa attcaagtat atcgttcgat tatgaaaatt 33000
ttcgaagaat atcccatttg agagagtctt tacctcatta atgtttttag attatgaaat 33060
tttatcatag ttcatcgtag tctttttggt gtaaaggctg taaaaagaaa ttgttcactt 33120
ttgttttcgt ttatgtgaag gctgtaaaag attgtaaaag actattttgg tgttttggat 33180
aaaatgatag tttttataga ttcttttgct tttagaagaa atacatttga aattttttcc 33240
atgttgagta taaaataccg aaatcgattg aagatcatag aaatatttta actgaaaaca 33300
aatttataac tgattcaatt ctctccattt ttatacctat ttaaccgtaa tcgattctaa 33360
tagatgatcg atttttttata taatcctaat taaccaacgg catgtattgg ataattaacc 33420
gatcaactct cacccctaat agaatcagta ttttccttcg acgttaattg atcctacact 33480
atgtaggtca tatccatcgt tttaattttt ggccaccatt caattctgtc ttgcctttag 33540
ggatgtgaat atgaacggcc aaggtaagag aataaaaaata atccaaatta aagcaagaga 33600
ggccaagtaa gataatccaa atgtacactt gtcattgcca aaattagtaa aatactcggc 33660
atattgtatt cccacacatt attaaaatac cgtatatgta ttggctgcat ttgcatgaat 33720
aatactacgt gtaagcccaa aagaacccac gtgtagccca tgcaaagtta acactcacga 33780
ccccattcct cagtctccac tatataaacc caccatcccc aatctcacca aacccaccac 33840
acaactcaca actcactctc acaccttaaa gaaccaatca ccaccaaaaa aagttctttg 33900
ctttcgaagt tgccgcaacc taaacaggtt tttccttctt ctttcttctt attaactacg 33960
accttgtcct ttgcctatgt aaaattacta ggttttcatc agttacactg attaagttcg 34020
ttatagtgga agataaaatg ccctcaaagc attttgcagg atatctttga tttttcaaag 34080
atatggaact gtagagtttg atagtgttct tgaatgtggt tgcatgaagt ttttttggtc 34140
tgcatgttat tttttcctcg aaatatgttt tgagtccaac aagtgattca cttgggattc 34200
agaaagttgt tttctcaata tgtaacagtt tttttctatg gagaaaaatc atagggaccg 34260
ttggttttgg cttctttaat tttgagctca gattaaaccc attttacccg gtgttcttgg 34320
cagaattgaa aacagtacgt agtaccgcgc ctaccatgcc acctagtgct gctagtgaag 34380
gtggtgttgc tgaacttaga gctgctgaag ttgctagcta cactagaaag gctgttgacg 34440
aaagacctga cctcactata gttggtgacg ctgtttacga cgctaaggct tttagggacg 34500
agcaccctgg tggtgctcac ttcgttagcc ttttcggagg tagggacgct actgaggctt 34560
ttatggaata tcaccgtaga gcttggccta aggctaggat gtctaagttc ttcgttggtt 34620
cacttgacgc tagcgagaag cctactcaag ctgattcatc ttaccttaga ctttgcgctg 34680
aggttaacgc tcttttgcct aagggtagcg gaggattcgc tcctcctagc tactggctta 34740
aggctgctgc tcttgttgtt gctgctgtta gtatagaggg ttatatgctc cttaggggta 34800
agaccctttt gcttagcgtt ttccttggac tcgtgttcgc ttggatagga cttaatattc 34860
agcacgacgc taatcacggt gctcttagta gacactcagt gattaactac tgcctcggtt 34920
acgctcagga ttggataggt ggtaatatgg tgctttggct tcaagagcac gttgtgatgc 34980
accacctcca cactaacgac gttgacgctg atcctgatca aaaggctcac ggtgttctta 35040
gacttaagcc tactgacggt tggatgcctt ggcacgcact tcaacaactc tatatccttc 35100
ctggtgaggc tatgtacgct tttaagcttc ttttcttgga cgcccttgag cttcttgctt 35160
ggaggtggga gggtgagaag attagccctc ttgctagagc tttgttcgct cctgctgttg 35220
cttgtaagct tggattctgg gctagattcg ttgctctccc tctctggctt caacctactg 35280
ttcacactgc tttgtgtatc tgtgctactg tgtgtactgg tagcttctac ctcgccttct 35340
tcttctttat ctctcacaac ttcgacggtg ttggtagcgt tggacctaag ggatcacttc 35400
ctagatcagc tactttcgtt caacgtcagg ttgagactag ctctaacgtt ggtggttact 35460
ggcttggagt tcttaacggt ggacttaact ttcagataga gcaccacttg ttccctaggc 35520
ttcaccactc ttactacgct caaatagctc ctgtggttag gactcacata gagaagctcg 35580
gttttaagta ccgtcacttc cctaccgttg gatctaacct tagctcaatg cttcagcata 35640
tgggtaagat gggaactaga cctggtgctg agaagggtgg taaggctgag tagtgattaa 35700
tgaataattg attgctgctt taatgagata tgcgagacgc ctatgatcgc atgatatttg 35760
ctttcaattc tgttgtgcac gttgtaaaaa acctgagcat gtgtagctca gatccttacc 35820
gccggtttcg gttcattcta atgaatatat cacccgttac tatcgtattt ttatgaataa 35880
tattctccgt tcaatttact gattgtctac gtagcgtcac ctgacgttac gtaaggctac 35940
ctaggctcac gtgacgttac gtaacgctac gtagcgtcag gtgaggttag ctaacgctag 36000
ctagcctcac ctgacgttag gtaaggctac gtagcgtcac ctgagattag ctaagcctac 36060
ctagactcac gtgaccttag gtaacgctac gtagcgtcaa agctttacaa cgctacacaa 36120
aacttataac cgtaatcacc attcattaac ttaactacta tcacatgcat tcatgaattg 36180
aaacgagaag gatgtaaata gttgggaagt tatctccacg ttgaagagat cgttagcgag 36240
agctgaaaga ccgagggagg agacgccgtc aacacggaca gagtcgtcga ccctcacatg 36300
aagtaggagg aatctccgtg aggagccaga gagacgtctt tggtcttcgg tttcgatcct 36360

tgatctgacg gagaagacga gagaagtgcg actggactcc gtgaggacca acagagtcgt 36420
cctcggtttc gatcgtcggt attggtggag aaggcggagg aatctccgtg acgagccaga 36480
gagatgtcgt cggtcttcgg tttcgatcct tgatctgacg gagaagacga gagaagtgcg 36540
acgagactcc gtgaggacca acagagttgt cctcggtttc gatcgtcggt ttcggcggag 36600
aaggcggagg aatctccgtg aggagccaga gagacgtcgt tggtcttcgg tttcgatcct 36660
tgatctgttg gagaagacga gacaagtggg acgagactca acgacggagt cagagacgtc 36720
gtcggtcttc ggtttcggcc gagaaggcgg agtcggtctt cggtttcggc cgagaaggcg 36780
gaggagacgt cttcgatttg ggtctctcct cttgacgaag aaaacaaaga acacgagaaa 36840
taatgagaaa gagaacaaaa gaaaaaaaaa taaaaataaa aataaaattt ggtcctctta 36900
tgtggtgaca cgtggtttga aacccaccaa ataatcgatc acaaaaaacc taagttaagg 36960
atcggtaata acctttctaa ttaattttga tttatattaa atcactcttt ttatttataa 37020
accccactaa attatgcgat attgattgtc taagtacaaa aattctctcg aattcaatac 37080
acatgtttca tatatttagc cctgttcatt taatattact agcgcatttt taatttaaaa 37140
ttttgtaaac ttttttggtc aaagaacatt tttttaatta gagacagaaa tctagactct 37200
ttatttggaa taatagtaat aaagatatat taggcaatga gtttatgatg ttatgtttat 37260
atagtttatt tcattttaaa ttgaaaagca ttattttat cgaaatgaat ctagtataca 37320
atcaatattt atgtttttc atcagatact ttcctatttt ttggcacctt tcatcggact 37380
actgatttat ttcaatgtgt atgcatgcat gagcatgagt atacacatgt cttttaaaat 37440
gcatgtaaag cgtaacggac cacaaaagag gatccataca aatacatctc atcgcttcct 37500
ctactattct ccgacacaca cactgagcat ggtgcttaaa cactctggtg agttctagta 37560
cttctgctat gatcgatctc attaccattt cttaaatttc tctccctaaa tattccgagt 37620
tcttgatttt tgataacttc aggttttctc tttttgataa atctggtctt tccatttttt 37680
tttttttgtg gttaatttag tttcctatgt tcttcgattg tattatgcat gatctgtgtt 37740
tggattctgt tagattatgt attggtgaat atgtatgtgt ttttgcatgt ctggttttgg 37800
tcttaaaaat gttcaaatct gatgatttga ttgaagcttt tttagtgttg gtttgattct 37860
tctcaaaact actgttaatt tactatcatg ttttccaact ttgattcatg atgacacttt 37920
tgttctgctt tgttataaaa ttttggttgg tttgattttg taattatagt gtaattttgt 37980
taggaatgaa catgttttaa tactctgttt tcgatttgtc acacattcga attattaatc 38040
gataatttaa ctgaaaattc atggttctag atcttgttgt catcagatta tttgtttcga 38100
taattcatca aatatgtagt ccttttgctg atttgcgact gtttcatttt ttctcaaaat 38160
tgttttttgt taagtttatc taacagttat cgttgtcaaa agtctctttc attttgcaaa 38220
atcttctttt tttttttgtt tgtaactttg ttttttaagc tacacattta gtctgtaaaa 38280
tagcatcgag gaacagttgt cttagtagac ttgcatgttc ttgtaacttc tatttgtttc 38340
agtttgttga tgactgcttt gattttgtag gtcaaaccgc gccatgtctg ctagcggagc 38400
tttgttgcct gctatagctt tcgctgctta cgcttacgct acctacgctt atgctttcga 38460
gtggagccac gctaacggaa tcgataacgt ggatgctaga gagtggattg gagctttgtc 38520
tttgagactc cctgcaattg caaccacaat gtacctcttg ttctgccttg tgggacctag 38580
attgatggct aagagggagg cttttgatcc taagggattt atgctcgctt acaacgctta 38640
ccaaaccgct ttcaacgttg tggtgctcgg aatgttcgct agagagatct ctggattggg 38700
acaacctgtt tggggatcta ctatgccttg gagcgatagg aagtccttca agattttgtt 38760
gggagtgtgg ctccactaca acaataagta cctcgagttg ttggatactg tgttcatggt 38820
ggctaggaaa aagaccaagc agctctcttt cttgcacgtg taccaccacg ctttgttgat 38880
ttgggcttgg tggcttgttt gtcacctcat ggctaccaac gattgcatcg atgcttattt 38940
cggagctgct tgcaactctt tcatccacat cgtgatgtac tcctactacc tcatgtctgc 39000
tttgggaatt aggtgccctt ggaagagata tatcacccag gctcagatgt tgcaattcgt 39060
gatcgtgttc gctcacgctg ttttcgtgct cagacaaaag cactgccctg ttactttgcc 39120
ttgggcacaa atgttcgtga tgacaaatat gttggtgctc ttcggaaact tctacctcaa 39180
ggcttactct aacaagtcta ggggagatgg agcttcttct gttaagcctg ctgagactac 39240
tagagcacct tctgtgagaa gaaccaggtc aaggaagatc gattgatagt taatgaacta 39300
agtttgatgt atctgagtgc caacgtttac tttgtctttc ctttctttta ttggttatga 39360
ttagatgttt actatgttct ctcttttcg ttataaataa agaagttcaa ttcttctata 39420
gtttcaaacg cgattttaag cgtttctatt taggtttaca tgatttcttt tacaaaatca 39480
tctttaaaat acagtatatt tttagttttc ataaaatatt taaagaaatg aaagtttata 39540
aacattcact cctattctct aattaaggat ttgtaaaaca aaaattttgt aagcatatcg 39600
atttatgcgt tttgtcttaa ttagctcact aaataataaa taatagctta tgttgtggga 39660
ctgtttaatt acctaactta gaactaaaat caactctttg tgctagctag cctcagctga 39720
cgttacgtaa cgctaggtag cgtcacgtga cgttagctaa cgctaggtag cgtcagctga 39780
gcttacgtaa gcgcttaatt aaagtactga tatcggtacc aaatcgaatc caaaaattac 39840
ggatatgaat ataggcatat ccgtatccga attatccgtt tgacagctag caacgattgt 39900
acaattgctt ctttaaaaaa ggaagaaaga aagaaagaaa agaatcaaca tcagcgttaa 39960
caaacggccc cgttacggcc caaacggtca tatagagtaa cggcgttaag cgttgaaaga 40020
ctcctatcga aatacgtaac cgcaaacgtg tcatagtcag atcccctctt ccttcaccgc 40080
ctcaaacaca aaaataatct tctacagcct atatatacaa cccccccttc tatctctcct 40140
ttctcacaat tcatcatctt tctttctcta cccccaattt taagaaatcc tctcttctcc 40200
tcttcatttt caaggtaaat ctctctctct ctctctctct ctgttattcc ttgttttaat 40260
taggtatgta ttattgctag tttgttaatc tgcttatctt atgtatgcct tatgtgaata 40320
tctttatctt gttcatctca tccgtttaga agctataaat ttgttgattt gactgtgtat 40380
ctacacgtgg ttatgtttat atctaatcag atatgaattt cttcatattg ttgcgtttgt 40440

gtgtaccaat ccgaaatcgt tgattttttt catttaatcg tgtagctaat tgtacgtata 40500
catatggatc tacgtatcaa ttgttcatct gtttgtgttt gtatgtatac agatctgaaa 40560
acatcacttc tctcatctga ttgtgttgtt acatacatag atatagatct gttatatcat 40620
tttttttatt aattgtgtat atatatatgt gcatagatct ggattacatg attgtgatta 40680
tttacatgat tttgttattt acgtatgtat atatgtagat ctggactttt tggagttgtt 40740
gacttgattg tatttgtgtg tgtatatgtg tgttctgatc ttgatatgtt atgtatgtgc 40800
agctgaacca tggcggcggc aacaacaaca acaacaacat cttcttcgat ctccttctcc 40860
accaaaccat ctccttcctc ctccaaatca ccattaccaa tctccagatt ctccctccca 40920
ttctccctaa accccaacaa atcatcctcc tcctcccgcc gccgcggtat caaatccagc 40980
tctccctcct ccatctccgc cgtgctcaac acaaccacca atgtcacaac cactccctct 41040
ccaaccaaac ctaccaaacc cgaaacattc atctcccgat tcgctccaga tcaaccccgc 41100
aaaggcgctg atatcctcgt cgaggcttta gaacgtcaag gcgtagaaac cgtattcgct 41160
taccctggag gtacatcaat ggagattcac caagccttaa cccgctcttc ctcaatccgt 41220
aacgtccttc ctcgtcacga acaaggaggt gtattcgcag cagaaggata cgctcgatcc 41280
tcaggtaaac caggtatctg tatagccact tcaggtcccg gagctacaaa tctcgttagc 41340
ggattagccg atgcgttgtt agatagtgtt cctcttgtag caatcacagg acaagtccct 41400
cgtcgtatga ttggtacaga tgcgtttcaa gagactccga ttgttgaggt aacgcgttcg 41460
attacgaagc ataactatct tgtgatggat gttgaagata tcccaaggat tattgaagag 41520
gctttctttt tagctacttc tggtagacct ggacctgttt tggttgatgt tcctaaagat 41580
attcaacaac agcttgcgat tcctaattgg gaacaggcta tgagattacc tggttatatg 41640
tctaggatgc ctaaacctcc ggaagattct catttggagc agattgttag gttgatttct 41700
gagtctaaga agcctgtgtt gtatgttggt ggtggttgtc ttaattctag cgatgaattg 41760
ggtaggtttg ttgagcttac gggcatccct gttgcgagta cgttgatggg gctgggatct 41820
tatccttgtg atgatgagtt gtcgttacat atgcttggaa tgcatgggac tgtgtatgca 41880
aattacgctg tggagcatag tgatttgttg ttggcgtttg gggtaaggtt tgatgatcgt 41940
gtcacgggta aacttgaggc ttttgctagt agggctaaga ttgttcatat tgatattgac 42000
tcggctgaga ttgggaagaa taagactcct catgtgtctg tgtgtggtga tgttaagctg 42060
gctttgcaag ggatgaataa ggttcttgag aaccgagcgg aggagcttaa acttgatttt 42120
ggagtttgga ggaatgagtt gaacgtacag aaacagaagt ttccgttgag ctttaagacg 42180
tttggggaag ctattcctcc acagtatgcg attaaggtcc ttgatgagtt gactgatgga 42240
aaagccataa taagtactgg tgtcgggcaa catcaaatgt gggcggcgca gttctacaat 42300
tacaagaaac caaggcagtg gctatcatca ggaggccttg gagctatggg atttggactt 42360
cctgctgcga ttggagcgtc tgttgctaac cctgatgcga tagttgtgga tattgacgga 42420
gatggaagtt ttataatgaa tgtgcaagag ctagccacta ttcgtgtaga gaatcttcca 42480
gtgaaggtac ttttattaaa caaccagcat cttggcatgg ttatgcaatg ggaagatcgg 42540
ttctacaaag ctaaccgagc tcacacattt ctcggggacc cggctcagga ggacgagata 42600
ttcccgaaca tgttgctgtt tgcagcagct tgcgggattc cagcggcgag ggtgacaaag 42660
aaagcagatc tccgagaagc tattcagaca atgctggata caccaggacc ttacctgttg 42720
gatgtgattt gtccgcacca agaacatgtg ttgccgatga tcccgaatgg tggcactttc 42780
aacgatgtca taacggaagg agatggccgg attaaatact gagagatgaa accggtgatt 42840
atcagaacct tttatggtct ttgtatgcat atggtaaaaa aacttagttt gcaatttcct 42900
gtttgttttg gtaatttgag tttcttttag ttgttgatct gcctgctttt tggtttacgt 42960
cagactacta ctgctgttgt tgtttggttt cctttctttc attttataaa taaataatcc 43020
ggttcggttt actccttgtg actggctcag tttggttatt gcgaaatgcg aatggtaaat 43080
tgagtaattg aaattcgtta ttagggttct aagctgtttt aacagtcact gggttaatat 43140
ctctcgaatc ttgcatggaa aatgctctta ccattggttt ttaattgaaa tgtgctcata 43200
tgggccgtgg tttccaaatt aaataaaact acgatgtcat cgagaagtaa aatcaactgt 43260
gtccacatta tcagttttgt gtatacgatg aaatagggta attcaaaatc tagcttgata 43320
tgccttttgg ttcattttaa ccttctgtaa acatttttc agattttgaa caagtaaatc 43380
caaaaaaaaa aaaaaaaatc tcaactcaac actaaattat tttaatgtat aaaagatgct 43440
taaaacattt ggcttaaaag aaagaagcta aaaacataga gaactcttgt aaattgaagt 43500
atgaaaatat actgaattgg gtattatatg aatttttctg atttaggatt cacatgatcc 43560
aaaaaggaaa tccagaagca ctaatcagac attggaagta ggattaatca gtgatcagta 43620
actattaaat tcaattaacc gcggacatct acatttttga attgaaaaaa aattggtaat 43680
tactctttct ttttctccat attgaccatc atactcattg ctgatccatg tagatttccc 43740
ggacatgaag ccatttacaa ttgaatatat cct 43773

<210> 291
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 2 RB junction region

<400> 291
tatatttaaa ccagtcagca 20

<210> 292
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 2 LB junction region

<400> 292
aatatatcct cacatatgaa 20

<210> 293
<211> 2900
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 2 flanking sequence up to and including the right
border of the T-DNA

<400> 293
```
gaaaaacctg catctccaaa aatgttcaaa tggcttaaaa acagagaaaa tgagtggaat     60
attagataga tctaccttta tagaacacac aaaaatacat atctaaaatt attaaatctt    120
cctttaaatg agtggaagat gagaaccatg tgatgaaaaa cctgcaaaac aagataaatt    180
agtaagaaaa acatgagaca gaaacaataa attgatataa agtttgatgt ttataagttc    240
aaagggatta aagagaggtt tgagagtttt agaacgagga acataccatt tttgttgcag    300
ccatttgaga ggagaagaga gaatgtgtaa atgttttttt atataaggag acaaaaattc    360
caataaggtt aaatattttt gatcagaaga cttactagac gacttacttg taagtcgccc    420
agaagacttc aatattttta gcgggaaact aaaatatttt tagcgggagt tagaagaccc    480
taaacataac ccttaaacta aattaactaa ctaaatactt cataaaatca aattaaactt    540
aaaaagtgtt tactatacac agaaataatc acatgtagat ataaatttaa tttttcaaaa    600
aaacatttaa gctttccaaa atctaaccct aagaatacat acaatactac aacatatgtt    660
gccaaaccct agaccaaaga atatcatgat tcactacttt cactcatcta tgttgaaaac    720
aattcaattt tattatatct taatttatat cacttaaaac tgtttataat tacatgattt    780
taattttccg tttatcaaaa tattttttac aaaatttata aattattttt aggatcaact    840
ataccagacg acttccatgg acgccgtaca gaagactaaa cagaatctca caagactcag    900
aagacgtagc ggggatatat tcataaaaat gagttctgtt tttttgtttg gtcacaaggg    960
gctggttgta atttcacaag gcttttggat tacttttgca tttgattcaa gtttgggtat   1020
acttttgcaa tcaaaatcaa gttttgagtc atatttggta aatcgcccta tataaaataa   1080
aattttaaaa agtaatgaat ctacatattt tgtaattttt aaaaaattta gttaacaatt   1140
ataataacac aaaacttaag aaaaagttat aattgtcgta ttttttttctc ttttcttttc   1200
tatgtaatat ttttatataa gtaataatgt gaatagaatt tatcaaatca tatgttagaa   1260
taattattat ataattttat acatttaaaa atttaaatat aatcaagata tatacatgta   1320
tttatatatt accagatcag agcagatatc cgtttcccaa aattttaata tttgtgattt   1380
gcttcgattt taatggatat tgatttttag tattttttttg cttcaaaagt ttatggatat   1440
tcggaatttt cggatcgaat cgaaacgaat aacgcatcaa atcaaattta acggataaaa   1500
ccttagtaac acatgcataa accttagtga acttctcaag ctttcgattc tctatcttat   1560
ttatctatga aattaattaa cataattttc cttgaattaa cataattgga ctaacgcata   1620
ttcgagctga agtcaaaatt cccaaaactt gttcttgata tgagtaaaac tgttcgtctg   1680
atgtaaactc ttactgtagt tgtattacaa actaatgata aagtatgcat tttctatttt   1740
attataaatt tacattacta gttgataaca tattgacaac tagaaagcgt gagagagaga   1800
tactcggtaa gccgagatgt atatccacag ttggagtctt tggatttcat atccagaatt   1860
gggtcgcaaa ctttcagtac aaagttatga catctccatg gtatatatcg acgtgtctat   1920
atatcatatt aaagaaaggt ttgtagtatt tggttaggta caaatgcgat caacttttga   1980
atttatatcc atgtacatat ataccccttgg ttacaaggac acctacccat acatacgcat   2040
aagtgacaaa tagcaaaata tctacacatc gcatgacccc gttctttttt atgataaggt   2100
tgtgattttt gtggttcttt tttttcatct cttacattga ttcagtatgt tgtccaaaaa   2160
aaaaacagtg attcagtatt atatcgagta aattcacaag aacgtagcta caatgtagat   2220
gatttattaa caattttaca agagacaagc aaatgtcgag caatcatatt ctataatatc   2280
aacctaaaag agttaaatcc ataaaattag ttggcaacga gcgatagtat gaaagttagg   2340
tgatgacaaa agttgctata ttgcttcaac tatattttca taaatttatt tgtctggatg   2400
aaaaccacaa aattttaaaa atataatttt gattggtaat atgtaaataa cgggatccta   2460
tatttaaacc agtcagcatc atcacaccaa aagttaggcc cgaatagttt gaaattagaa   2520
agctcgcaat tgaggtctac aggccaaatt cgctcttagc cgtacaatat tactcaccgg   2580
tgcgatgccc cccatcgtag gtgaaggtgg aaattaatgg cgcgcctgat cactgattag   2640
taactattac gtaagcctac gtagcgtcac gtgacgttag ctaacgctac gtagcctcag   2700
ctgacgttac gtaagcctac gtagcgtcac gtgagcttag ctaacgctac ctaggctcag   2760
ctgacgttac gtaacgctag ctagcgtcac tcctgcagca aatttacaca ttgccactaa   2820
```

acgtctaaac ccttgtaatt tgtttttgtt ttactatgtg tgttatgtat ttgatttgcg 2880
ataaattttt atatttggta 2900

<210> 294
<211> 1800
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 2 flanking sequence up to and including the left border of the T-DNA

<400> 294
tttttctgat ttaggattca catgatccaa aaaggaaatc cagaagcact aatcagacat 60
tggaagtagg attaatcagt gatcagtaac tattaaattc aattaaccgc ggacatctac 120
atttttgaat tgaaaaaaaa ttggtaatta ctctttcttt ttctccatat tgaccatcat 180
actcattgct gatccatgta gatttcccgg acatgaagcc atttacaatt gaatatatcc 240
tcacatatga aatatatttt ttttttacaa attacaccta ttaaattata cttgatcggt 300
catctgatat atttgaaaga accctatcag ccagctattc ataatttaca taaaagaaaa 360
ttacgtgctt aaaatctctc taaaaaaaaa aaaagacaaa gacatcaaac tgatccatga 420
aagtaaaatg gagtgtattt taattttatc ttcagaccaa tgttatcaat gtagcccata 480
tattaatact aaaacaactt ctgcacaaac acacgaatca aagcctcgtg tttcatcgta 540
gctttagcta aaatttccca aaagcaaatt caatagtatt ttactaggtc aaacccacaa 600
gagaaaaaga aagtcaatcc caaggatcaa gaaatgagaa gtgagaggag aatgctttat 660
tgggtttgct aataactaat aagacatgaa gcagactgaa aacatctggt tttgtccaaa 720
aaagaaggaa gtcagattcc aaaactgcgc acctacattg tttaatactc actcacacat 780
acattcatgt ttttactgtt tatacacagt caataattta tacacagctc catgttttaa 840
tatttaccca tctctctttt gtagtctatc gtagactttc acttgtgtcc ccctcatgcg 900
gcaacatcct cagcaacttg atttactata tacaataata caaatcataa gatatttgtt 960
aggagctggt ttgtaaatta tttcgataca atactgaagc gaagggacca gcaatctttt 1020
tagctgatca gaacaatctt actaacgtgt gtctttgtaa gaaaatccaa cttttacttt 1080
ttcaggaggg agtgtagcgg attatgtata aataactcga agagtggtgc acaaagttca 1140
agtgtttgtg taaaatgttc gacaagacat tgactaaagc attccgaaca tgtcaacaaa 1200
actacaattc taaaattgca aaaagctgct aaacggtgga atagcattta acacgcattc 1260
tataccaaac atttttttc ttgaacacca aagaaaccaa acctaatgtc aaccatcgta 1320
tggaaactat agaactaaat caaactaaca aattcttatt gtatattctt aaaaacatcc 1380
ttataagaca gtttttccaa atgaatcttt agacttcatt gtactaatat gtttaaaata 1440
atataattat gtatttaatt tcttgaaagt ttcgctgcta agaggcaatt atctttttat 1500
atttttttct ctcttatttt caaattctaa ttaattttct tggagagttt atccgatgat 1560
gatattctta tttcaactca atccacgagt aaatgtgtta gcaccacatc taaccatttg 1620
gagcttgtac tagctctatc tttccaaact taactttctt gagtgcttat ttatataaag 1680
catcagtata tggcccaacc caagaaaagc tgaacaaaat tagcaacaat agcaagggac 1740
gaactgcagc tcttcttggt tgtcgtgcct tccaattctc gactttccgt ggaagaacat 1800

<210> 295
<211> 25
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 2_Forward primer

<400> 295
ccatattgac catcatactc attgc 25

<210> 296
<211> 26
<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK Locus 2_Reverse primer

<400> 296
tggctgatag ggttctttca aatata 26

<210> 297
<211> 25

<212> DNA
<213> Artificial sequence

<220>
<223> LBFLFK locus 2_Probe

<400> 297
taaattatac ttgatcggtc atctg 25

<210> 298
<211> 45777
<212> DNA
<213> Artificial sequence

<220>
<223> contig of insert and flanking sequences of LBFDAU T-DNA locus 1

<400> 298
```
aaaagaaata taaaagaata tgaccaaaaa agtaaacgtg agtgagagaa taagaaaatg     60
actacaaaat ataatagcct caattatctt caaaactaag ttgacattta attatgcttt    120
tgcaagatat ttacttttgt tgttcgatca tatttaatga ttattttggt tttgaaacaa    180
atattaacat tatatatatt gtgtctatat tgaactgttg taaattataa acatcaaaat    240
tttaatgtta tcttaattat aatttctaat actagtatat tcaaaaatca aaataaacat    300
attttataaa atagtgccag tacgtagtat gggagataat actagtggct ttataaaggg    360
aaacattgtc tctaaaatct cagataaaat gttaaaacac acttattcac aattatgaag    420
atttgaaata tctgaaattt caaattgatg cacttggtag aaagcaaagg ttcaacgcta    480
agtctacaag gtgtaataat gaagtgaaaa tgctagttta gattacccctt gatatgtgac    540
tgaacatagg gtggagcgtc agtgagtcca tggagtacag aagctaaaca agagacatgg    600
ttaagcacca gaatcaactc gttctccata gagtccagct tttgagatat atgtgaatag    660
ccttgttgca atatacttgt gagtggcagg cgtgatctta ttaacgaaag tccaaattct    720
gaacaaagtt tatatcaagc tacgatggaa atatggaatc cgtatcaaaa tcaactgtac    780
tgtatcatac ggtgcagatt tttagctcga ctctaccacc ttgcgtttac ttttgtgatg    840
aacattgcga ttatatatga ggacctaaat agagggaaaa tgtatgaaga caggatccta    900
agaatgaaaa accagcatcc ccaagatgtg gcaccaagtg ctatcgacca caaactacgc    960
tggacatact ctgatatagt tcgttaagaa atcaaaatgt caacacatat aaataagcag   1020
tcagcatcat cacaccaaaa gttaggcccg aatagtttga aattagaaag ctcgcaattg   1080
aggtctacag gccaaattcg ctcttagccg tacaatatta ctcaccggtg cgatgccccc   1140
catcgtaggt gaaggtggaa attaatggcg cgcctgatca ctgattagta actattacgt   1200
aagcctacgt agcgtcacgt gacgttagct aacgctacgt agcctcagct gacgttacgt   1260
aagcctacgt agcgtcacgt gagcttagct aacgctacct aggctcagct gacgttacgt   1320
aacgctagct agcgtcactc ctgcagcaaa tttacacatt gccactaaac gtctaaaccc   1380
ttgtaatttg tttttgtttt actatgtgtg ttatgtattt gatttgcgat aaatttttat   1440
atttggtact aaatttataa caccttttat gctaacgttt gccaacactt agcaatttgc   1500
aagttgatta attgattcta aattattttt gtcttctaaa tacatatact aatcaactgg   1560
aaatgtaaat atttgctaat atttctacta taggagaatt aaagtgagtg aatatggtac   1620
cacaaggttt ggagatttaa ttgttgcaat gctgcatgga tggcatatac accaaacatt   1680
caataattct tgaggataat aatggtacca cacaagattt gaggtgcatg aacgtcacgt   1740
ggacaaaagg tttagtaatt tttcaagaca acaatgttac cacacacaag ttttgaggtg   1800
catgcatgga tgccctgtgg aaagtttaaa aatattttgg aaatgatttg catggaagcc   1860
atgtgtaaaa ccatgacatc cacttggagg atgcaataat gaagaaaact acaaatttac   1920
atgcaactag ttatgcatgt agtctatata atgaggattt tgcaatactt tcattcatac   1980
acactcacta agttttacac gattataatt tcttcatagc cagtactgtt taagcttcac   2040
tgtctctgaa tcggcaaagg taaacgtatc aattattcta caaacccttt tatttttctt   2100
ttgaattacc gtcttcattg gttatatgat aacttgataa gtaaagcttc aataattgaa   2160
tttgatctgt gtttttttgg ccttaatact aaatccttac ataagctttg ttgcttctcc   2220
tcttgtgagt tgagtgttaa gttgtaataa tggttcactt tcagctttag aagaaaccat   2280
ggaagttgtt gagaggttct acggagagtt ggatggaaag gtttcccaag gagtgaacgc   2340
tttgttggga tctttcggag ttgagttgac tgataccccca actactaagg gattgccact   2400
cgttgattct ccaactccaa ttgtgttggg agtgtctgtt tacttgacca tcgtgatcgg   2460
aggattgctt tggatcaagg ctagagatct caagccaaga gcttctgagc cattcttgtt   2520
gcaagctttg gtgttggtgc acaacttgtt ctgcttcgct ttgtctcttt acatgtgcgt   2580
gggtatcgct taccaagcta tcacctggag atattccttg tggggaaacg cttataaccc   2640
aaagcacaag gagatggcta tcctcgttta cctcttctac atgtccaagt acgtggagtt   2700
catggatacc gtgatcatga tcctcaagag atccaccaga cagatttctt tcctccacgt   2760
gtaccaccac tcttctatct cccttatctg gtgggctatt gctcaccacg ctccaggagg   2820
agaggcttat tggagtgctg ctctcaactc tggagtgcac gtgttgatgt acgcttacta   2880
cttcttggct gcttgcttga gatcttcccc aaagctcaag aacaagtacc tcttctgggg   2940
aagatacctc acccaattcc agatgttcca gttcatgctc aacttggtgc aagcttacta   3000
```

cgatatgaaa accaacgctc catatccaca atggctcatc aagatcctct tctactacat 3060
gatctccctc ttgttcctct tcggaaactt ctacgtgcaa aagtacatca agccatccga 3120
tggaaagcaa aagggagcta agaccgagtg atcgacaagc tcgagtttct ccataataat 3180
gtgtgagtag ttcccagata agggaattag ggttcctata gggtttcgct catgtgttga 3240
gcatataaga aacccttagt atgtatttgt atttgtaaaa tacttctatc aataaaattt 3300
ctaattccta aaaccaaaat ccagtactaa aatccagatc cccgaatta attcggcgtt 3360
aattcagcta gctagcctca gctgacgtta cgtaacgcta ggtagcgtca cgtgacgtta 3420
gctaacgcta ggtagcgtca gctgagctta cgtaagcgct tagcagatat ttggtgtcta 3480
aatgtttatt ttgtgatatg ttcatgtttg aaatggtggt ttcgaaacca gggacaacgt 3540
tgggatctga tagggtgtca aagagtatta tggattggga caatttcggt catgagttgc 3600
aaattcaagt atatcgttcg attatgaaaa ttttcgaaga atatcccatt tgagagagtc 3660
tttacctcat taatgttttt agattatgaa attttatcat agttcatcgt agtctttttg 3720
gtgtaaaggc tgtaaaaaga aattgttcac ttttgttttc gtttatgtga aggctgtaaa 3780
agattgtaaa agactatttt ggtgttttgg ataaaatgat agtttttata gattcttttg 3840
cttttagaag aaatacattt gaaatttttt ccatgttgag tataaaatac cgaaatcgat 3900
tgaagatcat agaaatattt taactgaaaa caaatttata actgattcaa ttctctccat 3960
ttttatacct atttaaccgt aatcgattct aatagatgat cgatttttta tataatccta 4020
attaaccaac ggcatgtatt ggataattaa ccgatcaact ctcaccccta atagaatcag 4080
tattttcctt cgacgttaat tgatcctaca ctatgtaggt catatccatc gttttaattt 4140
ttggccacca ttcaattctg tcttgccttt agggatgtga atatgaacgg ccaaggtaag 4200
agaataaaaa taatccaaat taaagcaaga gaggccaagt aagataatcc aaatgtacac 4260
ttgtcattgc caaaattagt aaaatactcg gcatattgta ttcccacaca ttattaaaat 4320
accgtatatg tattggctgc atttgcatga ataatactac gtgtaagccc aaaagaaccc 4380
acgtgtagcc catgcaaagt taacactcac gaccccattc ctcagtctcc actatataaa 4440
cccaccatcc ccaatctcac caaacccacc acacaactca caactcactc tcacacctta 4500
aagaaccaat caccaccaaa aaatttcacg atttggaatt tgattcctgc gatcacaggt 4560
atgacaggtt agattttgtt ttgtatagtt gtatacatac ttctttgtga tgttttgttt 4620
acttaatcga atttttggag tgttttaagg tctctcgttt agaaatcgtg gaaaatatca 4680
ctgtgtgtgt gttcttatga ttcacagtgt ttatgggttt catgttcttt gttttatcat 4740
tgaatgggaa gaaatttcgt tgggatacaa atttctcatg ttcttactga tcgttattag 4800
gagtttgggg aaaaaggaag agttttttttg gttggttcga gtgattatga ggttatttct 4860
gtatttgatt tatgagttaa tggtcgtttt aatgttgtag accatgggaa aaggatctga 4920
gggaagatct gctgctagag agatgactgc tgaggctaac ggagataaga gaaagaccat 4980
cctcattgag ggagtgttgt acgatgctac caacttcaaa cacccaggag gttccattat 5040
taacttcctc accgagggag aagctggagt tgatgctacc caagcttaca gagagttcca 5100
tcagagatcc ggaaaggctg ataagtacct caagtccctc ccaaagttgg atgcttctaa 5160
ggtggagtct aggttctctg ctaaggagca ggctagaagg gacgctatga ccagggatta 5220
cgctgctttc agagaggagt tggttgctga gggatacttc gatccatcta tcccacacat 5280
gatctacaga gtggtggaga ttgtggcttt gttcgctttg tctttctggt tgatgtctaa 5340
ggcttctcca acctctttgg ttttgggagt ggtgatgaac ggaatcgctc aaggaagatg 5400
cggatgggtt atgcacgaga tgggacacgg atctttcact ggagttatct ggctcgatga 5460
taggatgtgc gagttcttct acggagttgg atgtggaatg tctggacact actggaagaa 5520
ccagcactct aagcaccacg ctgctccaaa cagattggag cacgatgtgg atttgaacac 5580
cttgccactc gttgctttca acgagagagt tgtgaggaag gttaagccag gatctttgtt 5640
ggctttgtgg ctcagagttc aggcttattt gttcgctcca gtgtcttgct tgttgatcgg 5700
attgggatgg accttgtact tgcacccaag atatatgctc aggaccaaga gacacatgga 5760
gtttgtgtgg atcttcgcta gatatatcgg atggttctcc ttgatgggag ctttgggata 5820
ttctcctgga acttctgtgg gaatgtacct ctgctctttc ggacttggat gcatctacat 5880
cttcctccaa ttcgctgtgt ctcacaccca cttgccagtt accaacccag aggatcaatt 5940
gcactggctt gagtacgctg ctgatcacac cgtgaacatc tctaccaagt cttggttggt 6000
tacctggtgg atgtctaacc tcaacttcca aatcgagcac cacttgttcc caaccgctcc 6060
acaattcagg ttcaaggaga tctctccaag agttgaggct ctcttcaaga gacacaacct 6120
cccttactac gatttgccat acacctctgc tgtttctact accttcgcta acctctactc 6180
tgttggacac tctgttggag ctgataccaa gaagcaggat tgactgcttt aatgagatat 6240
gcgagacgcc tatgatcgca tgatatttgc tttcaattct gttgtgcacg ttgtaaaaaa 6300
cctgagcatg tgtagctcag atccttaccg ccggtttcgg ttcattctaa tgaatatatc 6360
acccgttact atcgtatttt tatgaataat attctccgtt caatttactg attgtctacg 6420
taggctcagc tgagcttacc taaggctacg taggctcacg tgacgttacg taaggctacg 6480
tagcgtcacg tgagcttacc taactctagc tagcctcacg tgaccttagc taacactagg 6540
tagcgtcagc tcgacggccc ggactgtatc caacttctga tctttgaatc tctctgttcc 6600
aacatgttct gaaggagttc taagactttt cagaaagctt gtaacatgct ttgtagactt 6660
tctttgaatt actcttgcaa actctgattg aacctacgtg aaaactgctc cagaagttct 6720
aaccaaattc cgtcttggga aggcccaaaa tttattgagt acttcagttt catggacgtg 6780
tcttcaaaga tttataactt gaaatcccat catttttaag agaagttctg ttccgcaatg 6840
tcttagatct cattgaaatc tacaactctt gtgtcagaag ttcttccaga atcaacttgc 6900
atcatggtga aaatctggcc agaagttctg aacttgtcat atttcttaac agttagaaaa 6960
atttctaagt gtttagaatt ttgacttttc caaagcaaac ttgacttttg actttcttaa 7020
taaaacaaac ttcatattct aacatgtctt gatgaaatgt gattcttgaa atttgatgtt 7080

gatgcaaaag tcaaagtttg acttttcagt gtgcaattga ccattttgct cttgtgccaa 7140
ttccaaacct aaattgatgt atcagtgctg caaacttgat gtcatggaag atcttatgag 7200
aaaattcttg aagactgaga ggaaaaattt tgtagtacaa cacaaagaat cctgtttttc 7260
atagtcggac tagacacatt aacataaaac accacttcat tcgaagagtg attgaagaag 7320
gaaatgtgca gttacctttc tgcagttcat aagagcaact tacagacact tttactaaaa 7380
tactacaaag aggaagattt taacaactta gagaagtaat gggagttaaa gagcaacaca 7440
ttaaggggga gtgttaaaat taatgtgttg taaccaccac tacctttagt aagtattata 7500
agaaaattgt aatcatcaca ttataattat tgtccttatt taaaattatg ataaagttgt 7560
atcattaaga ttgagaaaac caaatagtcc tcgtcttgat ttttgaatta ttgttttcta 7620
tgttactttt cttcaagcct atataaaaac tttgtaatgc taaattgtat gctggaaaaa 7680
aatgtgtaat gaattgaata gaaattatgg tatttcaaag tccaaaatcc atcaatagaa 7740
atttagtaca aaacgtaact caaaaatatt ctcttatttt aaattttaca acaatataaa 7800
aatattctct tattttaaat tttacaataa tataatttat cacctgtcac ctttagaata 7860
ccaccaacaa tattaatact tagatatttt attcttaata attttgagat ctctcaatat 7920
atctgatatt tattttatat ttgtgtcata ttttcttatg ttttagagtt aacccttata 7980
tcttggtcaa actagtaatt caatatatga gtttgtgaag gacacattga catcttgaaa 8040
cattggtttt aaccttgttg gaatgttaaa ggtaataaaa cattcagaat tatgaccatc 8100
tattaatata cttcctttgt cttttaaaaa agtgtgcatg aaaatgctct atggtaagct 8160
agagtgtctt gctggcctgt gtatatcaat tccatttcca gatggtagaa actgccacta 8220
cgaataatta gtcataagac acgtatgtta acacacgtcc ccttgcatgt tttttgccat 8280
atattccgtc tctttctttt tcttcacgta taaaacaatg aactaattaa tagagcgatc 8340
aagctgaaca gttctttgct ttcgaagttg ccgcaaccta aacaggtttt tccttcttct 8400
ttcttcttat taactacgac cttgtccttt gcctatgtaa aattactagg ttttcatcag 8460
ttacactgat taagttcgtt atagtggaag ataaaatgcc ctcaaagcat tttgcaggat 8520
atctttgatt tttcaaagat atggaactgt agagtttgat agtgttcttg aatgtggttg 8580
catgaagttt ttttggtctg catgttattt tttcctcgaa atatgttttg agtccaacaa 8640
gtgattcact tgggattcag aaagttgttt tctcaatatg taacagtttt tttctatgga 8700
gaaaaatcat agggaccgtt ggttttggct tctttaattt tgagctcaga ttaaacccat 8760
tttacccggt gttcttggca gaattgaaaa cagtacgtag taccgcgcct accatgtgtg 8820
ttgagaccga gaacaacgat ggaatcccta ctgtggagat cgctttcgat ggagagagag 8880
aaagagctga ggctaacgtg aagttgtctg ctgagaagat ggaacctgct gctttggcta 8940
agaccttcgc tagaagatac gtggttatcg agggagttga gtacgatgtg accgatttca 9000
aacatcctgg aggaaccgtg attttctacg ctctctctaa cactggagct gatgctactg 9060
aggctttcaa ggagttccac cacagatcta gaaaggctag gaaggctttg gctgctttgc 9120
cttctagacc tgctaagacc gctaaagtgg atgatgctga gatgctccag gatttcgcta 9180
agtggagaaa ggagttggag agggacggat tcttcaagcc ttctcctgct catgttgctt 9240
acagattcgc tgagttggct gctatgtacg ctttgggaac ctacttgatg tacgctagat 9300
acgttgtgtc ctctgtgttg gtttacgctt gcttcttcgg agctagatgt ggatgggttc 9360
aacacgaggg aggacactct tctttgaccg gaaacatctg gtgggataag agaatccaag 9420
ctttcactgc tggattcgga ttggctggat ctggagatat gtggaactcc atgcacaaca 9480
agcaccacgc tactcctcaa aaagtgaggc acgatatgga tttggatacc actcctgctg 9540
ttgctttctt caacaccgct gtggaggata atagacctag ggggattctct aagtactggc 9600
tcagattgca agcttggacc ttcattcctg tgacttctgg attggtgttg ctcttctgga 9660
tgttcttcct ccacccttct aaggctttga agggaggaaa gtacgaggag cttgtgtgga 9720
tgttggctgc tcacgtgatt agaacctgga ccattaaggc tgttactgga ttcaccgcta 9780
tgcaatccta cggactcttc ttggctactt cttgggtttc cggatgctac ttgttcgctc 9840
acttctctac ttctcacacc cacttggatg ttgttcctgc tgatgagcac ttgtcttggg 9900
ttaggtacgc tgtggatcac accattgata tcgatccttc tcagggatgg gttaactggt 9960
tgatgggata cttgaactgc caagtgattc accacctctt cccttctatg cctcaattca 10020
gacaacctga ggtgtccaga agattcgttg ctttcgctaa gaagtggaac ctcaactaca 10080
aggtgatgac ttatgctgga gcttggaagg ctactttggg aaacctcgat aatgtgggaa 10140
agcactacta cgtgcacgga caacactctg gaaagaccgc ttgattaatg aaggccgcct 10200
cgaccgtacc ccctgcagat agactatact atgttttagc ctgcctgctg gctagctact 10260
atgttatgtt atgttgtaaa ataaacacct gctaaggtat atctatctat attttagcat 10320
ggctttctca ataaattgtc tttccttatc gtttactatc ttatacctaa taatgaaata 10380
ataatatcac atatgaggaa cggggcaggt ttaggcatat atatacgagt gtagggcgga 10440
gtggggctac gtagcgtcac gtgacgttac ctaagcctag gtagcctcag ctgacgttac 10500
gtaacgctag gtaggctcag ctgacacggg caggacatag ggactactac aagcatagta 10560
tgcttcagac aaagagctag gaaagaactc ttgatggagg ttaagagaaa aaagtgctag 10620
aggggcatag taatcaaact tgtcaaaacc gtcatcatga tgagggatga cataatataa 10680
aaagttgact aaggtcttgg tagtactctt tgattagtat tatatattgg tgagaacatg 10740
agtcaagagg agacaagaaa ccgaggaacc atagtttagc aacaagatgg aagttgcaaa 10800
gttgagctag ccgctcgatt agttacatct cctaagcagt actacaagga atggtctcta 10860
tactttcatg tttagcacat ggtagtgcgg attgacaagt tagaaacagt gcttaggaga 10920
caaagagtca gtaaaggtat tgaaagagtg aagttgatgc tcgacaggtc aggagaagtc 10980
cctccgccag atggtgacta ccaaggggtt ggtatcagct gagacccaaa taagattctt 11040
cggttgaacc agtggttcga ccgagactct tagggtggga tttcactgta agatttgtgc 11100
attttgttga atataaattg acaatttttt ttatttaatt atagattatt tagaatgaat 11160

tacatattta gtttctaaca aggatagcaa tggatgggta tgggtacagg ttaaacatat 11220
ctattaccca cccatctagt cgtcgggttt tacacgtacc cacccgttta cataaaccag 11280
accggaattt taaaccgtac ccgtccgtta gcgggtttca gatttacccg tttaatcggg 11340
taaaacctga ttactaaata tatatttttt atttgataaa caaaacaaaa atgttaatat 11400
tttcatattg gatgcaattt taagaaacac atattcataa atttccatat ttgtaggaaa 11460
ataaaaagaa aaatatattc aagaacacaa atttcaccga catgactttt attacagagt 11520
tggaattaga tctaacaatt gaaaaattaa aattaagata gaatatgttg aggaacatga 11580
catagtataa tgctgggtta cccgtcgggt aggtatcgag gcggatacta ctaaatccat 11640
cccactcgct atccgataat cactggtttc gggtataccc attcccgtca acaggccttt 11700
ttaaccggat aatttcaact tatagtgaat gaattttgaa taaatagtta gaataccaaa 11760
atcctggatt gcatttgcaa tcaaattttg tgaaccgtta aattttgcat gtacttggga 11820
tagatataat agaaccgaat tttcattagt ttaatttata acttactttg ttcaaagaaa 11880
aaaaatatct atccaattta cttataataa aaaataatct atccaagtta cttattataa 11940
tcaacttgta aaaaggtaag aatacaaatg tggtagcgta cgtgtgatta tatgtgacga 12000
aatgttatat ctaacaaaag tccaaattcc catggtaaaa aaaatcaaaa tgcatggcag 12060
gctgtttgta accttggaat aagatgttgg ccaattctgg agccgccacg tacgcaagac 12120
tcagggccac gttctcttca tgcaaggata gtagaacacc actccaccca cctcctatat 12180
tagacctttg cccaaccctc cccaactttc ccatcccatc cacaaagaaa ccgacatttt 12240
tatcataaat ctggtgctta aacactctgg tgagttctag tacttctgct atgatcgatc 12300
tcattaccat ttcttaaatt tctctcccta aatattccga gttcttgatt tttgataact 12360
tcaggttttc tctttttgat aaatctggtc tttccatttt tttttttgt ggttaattta 12420
gtttcctatg ttcttcgatt gtattatgca tgatctgtgt ttggattctg ttagattatg 12480
tattggtgaa tatgtatgtg tttttgcatg tctggttttg gtcttaaaaa tgttcaaatc 12540
tgatgatttg attgaagctt ttttagtgtt ggtttgattc ttctcaaaac tactgttaat 12600
ttactatcat gttttccaac tttgattcat gatgacactt ttgttctgct ttgttataaa 12660
attttggttg gtttgatttt gtaattatag tgtaattttg ttaggaatga acatgtttta 12720
atactctgtt ttcgatttgt cacacattcg aattattaat cgataattta actgaaaatt 12780
catggttcta gatcttgttg tcatcagatt atttgtttcg ataattcatc aaatatgtag 12840
tccttttgct gatttgcgac tgtttcattt tttctcaaaa ttgtttttttg ttaagtttat 12900
ctaacagtta tcgttgtcaa aagtctcttt cattttgcaa aatcttcttt ttttttttgt 12960
ttgtaacttt gtttttttaag ctacacattt agtctgtaaa atagcatcga ggaacagttg 13020
tcttagtaga cttgcatgtt cttgtaactt ctatttgttt cagtttgttg atgactgctt 13080
tgattttgta ggtcaaaggc gcaccctacc atggatgctt ataacgctgc tatggataag 13140
attggagctg ctatcatcga ttggagtgat ccagatggaa agttcagagc tgatagggag 13200
gattggtggt tgtgcgattt cagatccgct atcaccattg ctctcatcta catcgctttc 13260
gtgatcttgg gatctgctgt gatgcaatct ctcccagcta tggacccata ccctatcaag 13320
ttcctctaca acgtgtctca aatcttcctc tgcgcttaca tgactgttga ggctggattc 13380
ctcgcttata ggaacggata caccgttatg ccatgcaacc acttcaacgt gaacgatcca 13440
ccagttgcta acttgctctg gctcttctac atctccaaag tgtgggattt ctgggatacc 13500
atcttcattg tgctcggaaa gaagtggaga caactctctt tcttgcacgt gtaccaccac 13560
accaccatct tcctcttcta ctggttgaac gctaacgtgc tctacgatgg agatatcttc 13620
ttgaccatcc tcctcaacgg attcattcac accgtgatgt acacctacta cttcatctgc 13680
atgcacacca aggattctaa gaccggaaag tctttgccaa tctggtggaa gtcatctttg 13740
accgctttcc aactcttgca attcaccatc atgatgtccc aagctaccta cttggttttc 13800
cacggatgcg ataaggtttc cctcagaatc accatcgtgt acttcgtgta cattctctcc 13860
cttttcttcc tcttcgctca gttcttcgtg caatcctaca tggctccaaa gaagaagaag 13920
tccgcttgat gttaatgaag gccgcagata tcagatctgg tcgacctaga ggatccccgg 13980
ccgcaaagat aataacaaaa gcctactata taacgtacat gcaagtattg tatgatatta 14040
atgtttttac gtacgtgtaa acaaaaaataa ttacgtttgt aacgtatggt gatgatgtgg 14100
tgcactaggt gtaggccttg tattaataaa aagaagtttg ttctatatag agtggtttag 14160
tacgacgatt tatttactag tcggattgga atagagaacc gaattcttca atccttgctt 14220
ttgatcaaga attgaaaccg aatcaaatgt aaaagttgat atatttgaaa aacgtattga 14280
gcttatgaaa atgctaatac tctcatctgt atggaaaagt gactttaaaa ccgaacttaa 14340
aagtgacaaa aggggaatat cgcatcaaac cgaatgaaac cgatctacgt aggctcagct 14400
gagcttagct aagcctacct agcctcacgt gagattatgt aaggctaggt agcgtcacgt 14460
gacgttacct aacactagct agcgtcagct gagcttagct aaccctacgt agcctcacgt 14520
gagcttacct aacgctacgt agcctcacgt gactaaggat gacctaccca ttcttgagac 14580
aaatgttaca ttttagtatc agagtaaaat gtgtacctat aactcaaatt cgattgacat 14640
gtatccattc aacataaaat taaaccagcc tgcacctgca tccacatttc aagtattttc 14700
aaaccgttcg gctcctatcc accgggtgta acaagacgga ttccgaattt ggaagatttt 14760
gactcaaatt cccaatttat attgaccgtg actaaatcaa ctttaacttc tataattctg 14820
attaagctcc caatttatat tcccaacggc actacctcca aaatttatag actctcatcc 14880
ccttttaaac caacttagta aacgtttttt ttttaatttt atgaagttaa gtttttacct 14940
tgtttttaaa aagaatcgtt cataagatgc catgccagaa cattagctac acgttacaca 15000
tagcatgcag ccgcggagaa ttgtttttct tcgccacttg tcactcccttc caaacaccta 15060
agagcttctc tctcacagca cacacataca atcacatgcg tgcatgcatt attacacgtg 15120
atcgccatgc aaatctcctt tatagcctat aaattaactc atcggcttca ctctttactc 15180
aaaccaaaac tcatcaatac aaacaagatt aaaaacattt cacgatttgg aatttgattc 15240

ctgcgatcac aggtatgaca ggttagattt tgttttgtat agttgtatac atacttcttt 15300
gtgatgtttt gtttacttaa tcgaattttt ggagtgtttt aaggtctctc gtttagaaat 15360
cgtggaaaat atcactgtgt gtgtgttctt atgattcaca gtgtttatgg gtttcatgtt 15420
ctttgtttta tcattgaatg ggaagaaatt tcgttgggat acaaatttct catgttctta 15480
ctgatcgtta ttaggagttt ggggaaaaag gaagagtttt tttggttggt tcgagtgatt 15540
atgaggttat ttctgtattt gatttatgag ttaatggtcg ttttaatgtt gtagaccgcc 15600
atggctattt tgaaccctga ggctgattct gctgctaacc tcgctactga ttctgaggct 15660
aagcaaagac aattggctga ggctggatac actcacgttg agggtgctcc tgctcctttg 15720
cctttggagt tgcctcactt ctctctcaga gatctcagag ctgctattcc taagcactgc 15780
ttcgagagat ctttcgtgac ctccacctac tacatgatca agaacgtgtt gacttgcgct 15840
gctttgttct acgctgctac cttcattgat agagctggag ctgctgctta tgttttgtgg 15900
cctgtgtact ggttcttcca gggatcttac ttgactggag tgtgggttat cgctcacgag 15960
tgtggacacc aggcttattg ctcttctgag gtggtgaaca acttgattgg actcgtgttg 16020
cactctgctt tgttggtgcc ttaccactct tggagaatct ctcacagaaa gcaccactcc 16080
aacactggat cttgcgagaa cgatgaggtt ttcgttcctg tgaccagatc tgtgttggct 16140
tcttcttgga acgagacctt ggaggattct cctctctacc aactctaccg tatcgtgtac 16200
atgttggttg ttggatggat gcctggatac ctcttcttca acgctactgg acctactaag 16260
tactggggaa agtctaggtc tcacttcaac ccttactccg ctatctatgc tgatagggag 16320
aggtggatga tcgtgctctc cgatattttc ttggtggcta tgttggctgt tttggctgct 16380
ttggtgcaca ctttctcctt caacacgatg gtgaagttct acgtggtgcc ttacttcatt 16440
gtgaacgctt acttggtgtt gattacctac ctccaacaca ccgataccta catccctcac 16500
ttcagagagg gagagtggaa ttggttgaga ggagctttgt gcactgtgga tagatcattt 16560
ggtccattcc tcgattctgt ggtgcataga atcgtggata cccacgtttg ccaccatatc 16620
ttctccaaga tgcctttcta tcactgcgag gaggctacca acgctattaa gcctctcctc 16680
ggaaagttct acttgaagga tactactcct gttcctgttg ctctctggag atcttacacc 16740
cactgcaagt tcgttgagga tgatggaaag gtggtgttct acaagaacaa gttatagtta 16800
atgaataatt gattggttcg agtattatgg cattgggaaa actgtttttc ttgtaccatt 16860
tgttgtgctt gtaatttact gtgtttttta ttcggttttc gctatcgaac tgtgaaatgg 16920
aaatggatgg agaagagtta atgaatgata tggtcctttt gttcattctc aaattaatat 16980
tatttgtttt ttctcttatt tgttgtgtgt tgaatttgaa attataagag atatgcaaac 17040
attttgtttt gagtaaaaat gtgtcaaatc gtggcctcta atgaccgaag ttaatatgag 17100
gagtaaaaca cttgtagttg taccattatg cttattcact aggcaacaaa tatattttca 17160
gacctagaaa agctgcaaat gttactgaat acaagtatgt cctcttgtgt tttagacatt 17220
tatgaacttt cctttatgta attttccaga atccttgtca gattctaatc attgctttat 17280
aattatagtt atactcatgg atttgtagtt gagtatgaaa atatttttta atgcatttta 17340
tgacttgcca attgattgac aacatgcatc aatctagcta gcctcagctg acgttacgta 17400
acgctaggta gcgtcacgtg acgttagcta acgctaggta gcgtcagctg agcttacgta 17460
agcgcacaga tgaatactag ctgttgttca cagttctagt gtctcctcat tacgtgaatt 17520
caagctacga tcactatctc aactcctaca taaacatcag aatgctacaa aactatgcac 17580
aaaaacaaaa gctacatcta atacgtgaat caattactct catcacaaga aagaagattt 17640
caatcaccgt cgagaaggag gattcagtta attgaatcaa agttccgatc aaactcgaag 17700
actggtgagc acgaggacga cgaagaagag tgtctcgaag atacaacaag caagaaatct 17760
actgagtgac ctcctgaagt tattggcgcg attgagagaa tcaatccgaa ttaatttcgg 17820
ggaaaaagat aaattagata ctaagcgatg ggcttgggct gggctaagaa acaggtggca 17880
attgggctgg aggaccccgc gattcatagc ttccgatagc ccaaaaaaaa acggataaca 17940
tatttatcgg gtatttgaat ttcagtgaaa taagatattt tctttttgtt aggaaaattt 18000
tagaaaataa tggaaattaa atagcgatta tgttacaaga tacgatcagc atcgggcagt 18060
gcaaaatgct atagcttccc aagatttgat ccttttgggt tatctcctaa tgacaattag 18120
tttaggattt tgaaacttat attaatacta ttatccgaca acacttgttt cagcttctta 18180
ttttaacatt ttttgttttt ttctattctt cttcccatca gcattttctt tttaaaaaat 18240
tgaatacttt aactttttaa aaatttcaca atgatcagat gatattatgg aagatctcaa 18300
gagttaaatg tatccatctt ggggcattaa aaccggtgta cgggatgata aatacagact 18360
ttatatcata tgatagctca gtaattcata tttatcacgt tgctaaaaaa attataaggt 18420
actagtagtc aacaaaatca attaaagaga aagaaagaaa cgcatgtgaa gagagtttac 18480
aactggaaaa gtaaaataaa aattaacgca tgttgaatgc tgacatgtca gtatgtccat 18540
gaatccacgt atcaagcgcc attcatcgat cgtcttcctc tttctaaatg aaaacaactt 18600
cacacatcac aacaaacaat acacacaaga ccccctctct ctcgttgtct ctctgccagc 18660
gaccaaatcg aagcttgaga agaacaagaa ggggtcaaac catggcttct acatctgctg 18720
ctcaagacgc tgctccttac gagttccctt ctctcactga gatcaagagg gctcttcctt 18780
ctgagtgttt cgaggcttct gttcctcttt ctctctacta caccgctaga tctcttgctc 18840
ttgctggatc tctcgctgtt gctctctctt acgctagagc tttgcctctt gttcaggcta 18900
acgctcttct tgatgctact ctctgcactg gatacgttct tctccaggga atcgttttct 18960
ggggattctt caccgttggt cacgattgtg gacacggagc tttctctaga tctcacgtgc 19020
tcaacttctc tgttggaacc ctcatgcact ctatcatcct taccccttc gagtcttgga 19080
agctctctca cagacaccac cacaagaaca ccggaaacat cgataaggac gagatcttct 19140
accctcaaag agaggctgat tctcaccctg tttctagaca ccttgtgatg tctcttggat 19200
ctgcttggtt cgcttacctt ttcgctggat tccctcctag aaccatgaac cacttcaacc 19260
cttgggaggc tatgtatgtt agaagagtgg ctgctgtgat catctctctc ggagttcttt 19320

tcgctttcgc tggactctac tcttacctca ccttcgttct tggattcacc actatggcta 19380
tctactactt cggacctctc ttcatcttcg ctaccatgct tgttgttacc actttcctcc 19440
accacaacga tgaggagaca ccttggtacg ctgattctga gtggacttac gtgaagggaa 19500
acctctcttc tgtggacaga tcttacggtg ctctcatcga caaccttagc cacaacatcg 19560
gaactcacca gatccaccac ctcttcccta tcatccctca ctacaagctc aacgatgcta 19620
ctgctgcttt cgctaaggct ttccctgagc ttgttaggaa aaacgctgct cctatcatcc 19680
caactttctt caggatggct gctatgtacg ctaagtacgg agttgttgac actgatgcta 19740
agaccttcac tctcaaggag gctaaggctg ctgctaagac taagtcatct tgatgattaa 19800
tgaataattg attgtacata ctatattttt tgtttacctt gtgttagttt aatgttcagt 19860
gtcctctctt tattgtggca cgtctctttg ttgtatgttg tgtctataca aagttgaaat 19920
aatggaaaga aaaggaagag tgtaatttgt tttgttttaa gtgtttataa atatatatat 19980
ataggtcatt tagatagttc taggtttcta taaaactctc tctctggaag tagaatctgt 20040
ttttgagagg atccagttgc ctactaatct cccccaaaac ccttcaagct taaccttcct 20100
cttcacaaca acagaggaaa cacatctctt gagctctgag ttctcttctt tgagcatgtc 20160
tatcgctaaa ctcatctgcc ttatagcttc cctcttctct tcatctctct ctctcaccat 20220
ttcgctgtaa aacttattct cctccctcag cctctctatc tcttccttca gcatctcaca 20280
attcccacca taatcgactg aggatgattc accgtcatca acttcagact cagcgttgta 20340
gtcgtcatga gtctcacaag ccttggacca agaagactca tcatcgcaag ttgatgattt 20400
atcatgatgc ttctctgagc cgtgtttgct acgtagcgtc acgtgacgtt acctaagcct 20460
aggtagcctc agctgacgtt acgtaacgct aggtaggctc agctgactgc agcaaattta 20520
cacattgcca ctaaacgtct aaacccttgt aatttgtttt tgttttacta tgtgtgttat 20580
gtatttgatt tgcgataaat ttttatattt ggtactaaat ttataacacc ttttatgcta 20640
acgtttgcca acacttagca atttgcaagt tgattaattg attctaaatt atttttgtct 20700
tctaaataca tatactaatc aactggaaat gtaaatattt gctaatattt ctactatagg 20760
agaattaaag tgagtgaata tggtaccaca aggtttggag atttaattgt tgcaatgctg 20820
catggatggc atatacacca aacattcaat aattcttgag gataataatg gtaccacaca 20880
agatttgagg tgcatgaacg tcacgtggac aaaaggttta gtaatttttc aagacaacaa 20940
tgttaccaca cacaagtttt gaggtgcatg catggatgcc ctgtggaaag tttaaaaata 21000
ttttggaaat gatttgcatg gaagccatgt gtaaaaccat gacatccact tggaggatgc 21060
aataatgaag aaaactacaa atttacatgc aactagttat gcatgtagtc tatataatga 21120
ggattttgca atactttcat tcatacacac tcactaagtt ttacacgatt ataatttctt 21180
catagccagt actgtttaag cttcactgtc tctgaatcgg caaaggtaaa cgtatcaatt 21240
attctacaaa ccctttttatt tttcttttga attaccgtct tcattggtta tatgataact 21300
tgataagtaa agcttcaata attgaatttg atctgtgttt ttttggcctt aatactaaat 21360
ccttacataa gctttgttgc ttctcctctt gtgagttgag tgttaagttg taataatggt 21420
tcactttcag ctttagaaga aacgcgcctt ccatggctac aaaggaggct tacgttttcc 21480
caactctcac cgagatcaag agatctctcc caaaggattg cttcgaggct tctgtgcctt 21540
tgtctctcta ctacactgtg agatgcttgg ttattgctgt ggctttgacc ttcggattga 21600
actacgctag agctttgcca gaggttgagt ctttctgggc tttggatgct gctttgtgca 21660
ctggatatat cctcctccag ggaattgtgt tctggggatt cttcactgtt ggacacgatg 21720
ctggacacgg agctttctct agataccacc tcttgaactt cgttgtggga accttcatgc 21780
actctctcat cttgacccca ttcgagtctt ggaagttgac ccacagacac caccacaaga 21840
acaccggaaa catcgataga gatgaggtgt tctacccaca gagaaaggct gatgatcacc 21900
cattgtccag gaacttgatc ttggctttgg gagctgcttg gcttgcttat ttggtggagg 21960
gattcccacc aagaaaggtg aaccacttca acccattcga gccacttttt gtgagacaag 22020
tgtccgctgt ggttatctct ttgctcgctc acttcttcgt tgctggactc tctatctact 22080
tgtctctcca gttgggactt aagaccatgg ctatctacta ctacggacca gttttcgtgt 22140
tcggatctat gttggtgatt accaccttct tgcaccacaa cgatgaggag actccatggt 22200
atgctgattc tgagtggact tacgtgaagg gaaacttgtc ctctgtggat agatcttacg 22260
gtgctctcat cgataacctc tcccacaaca tcggaactca ccagatccac cacctcttcc 22320
caattatccc acactacaag ctcaagaagg ctactgctgc tttccaccaa gctttcccag 22380
agcttgtgag aaagtccgat gagccaatca tcaaggcttt cttcagagtg ggaaggttgt 22440
atgctaacta cggagtggtt gatcaagagg ctaagctctt cactttgaag gaggctaagg 22500
ctgctactga agctgctgct aagaccaagt ctacctgatt aatgaatcga caagctcgag 22560
tttctccata ataatgtgtg agtagttccc agataaggga attagggttc ctatagggtt 22620
tcgctcatgt gttgagcata taagaaaccc ttagtatgta tttgtatttg taaaatactt 22680
ctatcaataa aatttctaat tcctaaaacc aaaatccagt actaaaatcc agatcccccg 22740
aattaattcg gcgttaattc agctacgtag gctcagctga gcttacctaa ggctacgtag 22800
gctcacgtga cgttacgtaa ggctacgtag cgtcacgtga gcttacctaa ctctagctag 22860
cctcacgtga ccttagctaa cactaggtag cgtcagcaca gatgaatact agctgttgtt 22920
cacagttcta gtgtctcctc attacgtgaa ttcaagctac gatcactatc tcaactccta 22980
cataaacatc agaatgctac aaaactatgc acaaaaacaa aagctacatc taatacgtga 23040
atcaattact ctcatcacaa gaaagaagat ttcaatcacc gtcgagaagg aggattcagt 23100
taattgaatc aaagttccga tcaaactcga agactggtga gcacgaggac gacgaagaag 23160
agtgtctcga agatacaaca agcaagaaat ctactgagtg acctcctgaa gttattggcg 23220
cgattgagag aatcaatccg aattaatttc ggggaaaaag ataaattaga tactaagcga 23280
tgggcttggg ctgggctaag aaacaggtgg caattgggct ggaggacccc gcgattcata 23340
gcttccgata gcccaaaaaa aaacggataa catatttatc gggtatttga atttcagtga 23400

aataagatat tttctttttg ttaggaaaat tttagaaaat aatggaaatt aaatagcgat 23460
tatgttacaa gatacgatca gcatcgggca gtgcaaaatg ctatagcttc ccaagatttg 23520
atccttttgg gttatctcct aatgacaatt agtttaggat tttgaaactt atattaatac 23580
tattatccga caacacttgt ttcagcttct tattttaaca ttttttgttt ttttctattc 23640
ttcttcccat cagcattttc tttttaaaaa attgaatact ttaacttttt aaaaatttca 23700
caatgatcag atgatattat ggaagatctc aagagttaaa tgtatccatc ttggggcatt 23760
aaaaccggtg tacgggatga taaatacaga ctttatatca tatgatagct cagtaattca 23820
tatttatcac gttgctaaaa aaattataag gtactagtag tcaacaaaat caattaaaga 23880
gaaagaaaga aacgcatgtg aagagagttt acaactggaa aagtaaaata aaaattaacg 23940
catgttgaat gctgacatgt cagtatgtcc atgaatccac gtatcaagcg ccattcatcg 24000
atcgtcttcc tctttctaaa tgaaaacaac ttcacacatc acaacaaaca atacacacaa 24060
gacccccctct ctctcgttgt ctctctgcca gcgaccaaat cgaagcttga gaagaacaag 24120
aaggggtcaa accatgggaa aaggatctga gggaagatct gctgctagag agatgactgc 24180
tgaggctaac ggagataaga gaaagaccat cctcattgag ggagtgttgt acgatgctac 24240
caacttcaaa cacccaggag gttccattat taacttcctc accgagggag aagctggagt 24300
tgatgctacc caagcttaca gagagttcca tcagagatcc ggaaaggctg ataagtacct 24360
caagtccctc ccaaagttgg atgcttctaa ggtggagtct aggttctctg ctaaggagca 24420
ggctagaagg gacgctatga ccagggatta cgctgctttc agagaggagt tggttgctga 24480
gggatacttc gatccatcta tcccacacat gatctacaga gtggtggaga ttgtggcttt 24540
gttcgctttg tctttctggt tgatgtctaa ggcttctcca acctctttgg ttttgggagt 24600
ggtgatgaac ggaatcgctc aaggaagatg cggatgggtt atgcacgaga tgggacacgg 24660
atctttcact ggagttatct ggctcgatga taggatgtgc gagttcttct acggagttgg 24720
atgtggaatg tctggacact actggaagaa ccagcactct aagcaccacg ctgctccaaa 24780
cagattggag cacgatgtgg atttgaacac cttgccactc gttgctttca acgagagagt 24840
tgtgaggaag gttaagccag gatctttgtt ggctttgtgg ctcagagttc aggcttattt 24900
gttcgctcca gtgtcttgct tgttgatcgg attgggatgg accttgtact tgcacccaag 24960
atatatgctc aggaccaaga gacacatgga gtttgtgtgg atcttcgcta gatatatcgg 25020
atggttctcc ttgatgggag ctttgggata ttctcctgga acttctgtgg gaatgtacct 25080
ctgctctttc ggacttggat gcatctacat cttcctccaa ttcgctgtgt ctcacaccca 25140
cttgccagtt accaacccag aggatcaatt gcactggctt gagtacgctg ctgatcacac 25200
cgtgaacatc tctaccaagt cttggttggt tacctggtgg atgtctaacc tcaacttcca 25260
aatcgagcac cacttgttcc caaccgctcc acaattcagg ttcaaggaga tctctccaag 25320
agttgaggct ctcttcaaga gacacaacct cccttactac gatttgccat acacctctgc 25380
tgtttctact accttcgcta acctctactc tgttggacac tctgttggag ctgataccaa 25440
gaagcaggat tgatgattaa tgaataattg attgtacata ctatattttt tgtttacctt 25500
gtgttagttt aatgttcagt gtcctctctt tattgtggca cgtctctttg ttgtatgttg 25560
tgtctataca aagttgaaat aatggaaaga aaaggaagag tgtaatttgt tttgttttaa 25620
gtgtttataa atatatatat ataggtcatt tagatagttc taggtttcta taaaactctc 25680
tctctggaag tagaatctgt ttttgagagg atccagttgc ctactaatct cccccaaaac 25740
ccttcaagct taaccttcct cttcacaaca acagaggaaa cacatctctt gagctctgag 25800
ttctcttctt tgagcatgtc tatcgctaaa ctcatctgcc ttatagcttc cctcttctct 25860
tcatctctct ctctcaccat ttcgctgtaa aacttattct cctccctcag cctctctatc 25920
tcttccttca gcatctcaca attcccacca taatcgactg aggatgattc accgtcatca 25980
acttcagact cagcgttgta gtcgtcatga gtctcacaag ccttggacca agaagactca 26040
tcatcgcaag ttgatgattt atcatgatgc ttctctgagc cgtgtttgct acctagagtc 26100
agctgagctt agctaacgct agctagtgtc agctgacgtt acgtaaggct aactagcgtc 26160
acgtgacctt acgtaacgct acgtaggctc agctgagctt agctaaccct agctagtgtc 26220
acgtgagctt acgctactat agaaaatgtg ttatatcgac atgaccagac aaaggggcaa 26280
cagttaacaa aacaattaat tctttcattt gagattaagg aaggtaaggt actaaaaaga 26340
ttaaaaaaaa tgagcttatc tctttgtttc tgtaataata atataagtgt gataaacttt 26400
taatataata attgtaatta ggttttctac agatgagcac cactcagaga caagataaga 26460
agaaaacaat tttgttaaac atgattatag aaacttttag ttaagtcttg aagtatcaat 26520
ataacaaaaa aaagtacaca cgactatgac aataaaccca ctaccgtcag gttatcattt 26580
cgatgaaatg ttttgatatc attaaatata acagtcacaa aaaatcatct aattataaca 26640
atataactta tacatatatt taactaaaaa cttagagttt ttgtaatgat tctaattgat 26700
gattagagtt tatagaaata caattaaata aaaaatataa ttttaaaaaa acatagtaaa 26760
gtcaatgaga tcctctctga cctcagtgat catttagtca tgtatgtaca acaatcattg 26820
ttcatcacat gactgtaaaa taaataagga taaacttggg aatatatata atatattgta 26880
ttaaataaaa aagggaaata caaatatcaa ttttagattc ccgagttgac acaactcacc 26940
atgcacgctg ccacctcagc tcccagctct cgtcacatgt ctcatgtcag ttaggtcttt 27000
ggtttttagt ctttgacaca actcgccatg catgttgcca cgtgagctcg ttcctcttcc 27060
catgatctca ccactgggca tgcatgctgc cacctcagct ggcacctctt ctctatatgt 27120
ccctagaggc catgcacagt gccacctcag cactcctctc agaacccata cgtacctgcc 27180
aatcggcttc tctccataaa tatctattta aattataact aattatttca tatacttaat 27240
tgatgacgtg gatgcattgc catcgttgtt taataattgt taattacgac atgataaata 27300
aaatgaaagt aaaaagtacg aaagattttc catttgttgt tgtataaata gagaagtgag 27360
tgatgcataa tgcatgaatg catgaccgcg ccaccatgac tgttggatac gacgaggaga 27420
tcccattcga gcaagttagg gctcataaca agccagacga cgcttggtgt gctattcacg 27480

gacacgtgta cgacgttacc aagttcgctt cagttcaccc aggaggagat attatcttgc 27540
tcgctgctgg aaaggaagct actgtcctct acgagaccta ccatgttaga ggagtgtctg 27600
acgctgtgct cagaaagtac agaataggaa agttgccaga cggacaagga ggagctaacg 27660
agaaggagaa gagaaccttg tctggattgt cctctgcttc ttactacacc tggaactccg 27720
atttctacag agtgatgagg gagagagttg tggctagatt gaaggagaga ggaaaggcta 27780
gaagaggagg atacgaactc tggatcaagg ctttcttgct ccttgttgga ttctggtcct 27840
ctctttactg gatgtgcacc ctcgatccat ctttcggagc tatcttggct gctatgtctt 27900
tgggagtgtt cgctgctttt gttggaacct gcatccaaca cgatggaaac cacggagctt 27960
tcgctcaatc tagatgggtt aacaaggtgg caggatggac tttggatatg atcggagctt 28020
ctggaatgac ttgggagttc caacacgtgt tgggacacca cccatacact aacttgatcg 28080
aggaggagaa cggattgcaa aaggtgtccg gaaagaagat ggataccaag ttggctgatc 28140
aagagtctga tccagatgtg ttctccacct acccaatgat gagattgcac ccttggcacc 28200
agaagaggtg gtatcacagg ttccagcaca tctacggacc tttcatcttc ggattcatga 28260
ccatcaacaa ggtggtgact caagatgttg gagtggtgtt gagaaagaga ctcttccaaa 28320
tcgatgctga gtgcagatat gcttccccaa tgtacgttgc taggttctgg attatgaagg 28380
ctttgaccgt gttgtatatg gttgctttgc cttgttatat gcaaggacct tggcacggat 28440
tgaaactctt cgctatcgct cacttcactt gcggagaggt tttggctacc atgttcatcg 28500
tgaaccacat tatcgaggga gtgtcttacg cttctaagga tgctgttaag ggaactatgg 28560
ctccaccaaa gactatgcac ggagtgaccc caatgaacaa cactagaaag gaggttgagg 28620
ctgaggcttc taagtctgga gctgtggtta agtctgtgcc attggatgat tgggctgctg 28680
ttcagtgcca aacctctgtg aactggtctg ttggatcttg gttttggaac cacttctctg 28740
gaggactcaa ccaccaaatc gagcaccacc tcttcccagg attgtctcac gagacctact 28800
accacatcca agacgtggtt caatctacct gtgctgagta cggagttcca taccaacacg 28860
agccatcttt gtggactgct tactggaaga tgctcgaaca ccttagacaa ttgggaaacg 28920
aggagactca cgagtcatgg cagagagctg cttgattaat gaactaagac tcccaaaacc 28980
accttccctg tgacagttaa accctgctta tacctttcct cctaataatg ttcatctgtc 29040
acacaaacta aaataaataa aatgggagca ataaataaaa tgggagctca tatatttaca 29100
ccatttacac tgtctattat tcaccatgcc aattattact tcataatttt aaaattatgt 29160
catttttaaa aattgcttaa tgatggaaag gattattata agttaaaagt ataacataga 29220
taaactaacc acaaaacaaa tcaatataaa ctaacttact ctcccatcta atttttattt 29280
aaatttcttt acacttctct tccatttcta tttctacaac attatttaac atttttattg 29340
tatttttctt actttctaac tctattcatt tcaaaaatca atatatgttt atcaccacct 29400
ctctaaaaaa aactttacaa tcattggtcc agaaaagtta aatcacgaga tggtcatttt 29460
agcattaaaa caacgattct tgtatcacta tttttcagca tgtagtccat tctcttcaaa 29520
caaagacagc ggctatataa tcgttgtgtt atattcagtc taaaacaact agctagcctc 29580
agctgacgtt acgtaacgct aggtagcgtc acgtgacgtt agctaacgct aggtagcgtc 29640
agctgagctt acgtaagcgc cacgggcagg acatagggac tactacaagc atagtatgct 29700
tcagacaaag agctaggaaa gaactcttga tggaggttaa gagaaaaaag tgctagaggg 29760
gcatagtaat caaacttgtc aaaaccgtca tcatgatgag ggatgacata atataaaaag 29820
ttgactaagg tcttggtagt actctttgat tagtattata tattggtgag aacatgagtc 29880
aagaggagac aagaaaccga ggaaccatag tttagcaaca agatggaagt tgcaaagttg 29940
agctagccgc tcgattagtt acatctccta agcagtacta caaggaatgg tctctatact 30000
ttcatgttta gcacatggta gtgcggattg acaagttaga aacagtgctt aggagacaaa 30060
gagtcagtaa aggtattgaa agagtgaagt tgatgctcga caggtcagga gaagtccctc 30120
cgccagatgg tgactaccaa ggggttggta tcagctgaga cccaaataag attcttcggt 30180
tgaaccagtg gttcgaccga gactcttagg gtgggatttc actgtaagat ttgtgcattt 30240
tgttgaatat aaattgacaa ttttttttat ttaattatag attatttaga atgaattaca 30300
tatttagttt ctaacaagga tagcaatgga tgggtatggg tacaggttaa acatatctat 30360
tacccaccca tctagtcgtc gggttttaca cgtacccacc cgtttacata aaccagaccg 30420
gaattttaaa ccgtacccgt ccgttagcgg gtttcagatt tacccgttta atcgggtaaa 30480
acctgattac taaatatata tttttatttt gataaacaaa acaaaaatgt taatattttc 30540
atattggatg caattttaag aaacacatat tcataaattt ccatatttgt aggaaaataa 30600
aaagaaaaat atattcaaga acacaaattt caccgacatg acttttatta cagagttgga 30660
attagatcta acaattgaaa aattaaaatt aagatagaat atgttgagga acatgacata 30720
gtataatgct gggttacccg tcgggtaggt atcgaggcgg atactactaa atccatccca 30780
ctcgctatcc gataatcact ggtttcgggt atacccattc ccgtcaacag gcctttttaa 30840
ccggataatt tcaacttata gtgaatgaat tttgaataaa tagttagaat accaaaatcc 30900
tggattgcat ttgcaatcaa attttgtgaa ccgttaaatt ttgcatgtac ttgggataga 30960
tataatagaa ccgaattttc attagtttaa tttataactt actttgttca aagaaaaaaa 31020
atatctatcc aatttactta taataaaaaa taatctatcc aagttactta ttataatcaa 31080
cttgtaaaaa ggtaagaata caaatgtggt agcgtacgtg tgattatatg tgacgaaatg 31140
ttatatctaa caaaagtcca aattcccatg gtaaaaaaaa tcaaaatgca tggcaggctg 31200
tttgtaacct tggaataaga tgttggccaa ttctggagcc gccacgtacg caagactcag 31260
ggccacgttc tcttcatgca aggatagtag aacaccactc cacccacctc ctatattaga 31320
cctttgccca accctcccca actttcccat cccatccaca aagaaaccga catttttatc 31380
ataaatcagg gtttcgtttt tgtttcatcg ataaactcaa aggtgatgat tttagggtct 31440
tgtgagtgtg ctttttgtt tgattctact gtagggttta tgttctttag ctcataggtt 31500
ttgtgtattt cttagaaatg tggcttcttt aatctctggg tttgtgactt tttgtgtggt 31560

```
ttctgtgttt ttcatatcaa aaacctattt tttccgagtt ttttttaca aattcttact  31620
ctcaagcttg aatacttcac atgcagtgtt cttttgtaga ttttagagtt aatgtgttaa  31680
aaagtttgga tttttcttgc ttatagagct tcttcacttt gattttgtgg gttttttgt  31740
tttaaaggtg agatttttga tgaggttttt gcttcaaaga tgtcaccttt ctgggtttgt  31800
cttttgaata aagctatgaa ctgtcacatg gctgacgcaa ttttgttact atgtcatgaa  31860
agctgacgtt tttccgtgtt atacatgttt gcttacactt gcatgcgtca aaaaaattgg  31920
ggctttttag ttttagtcaa agattttact tctcttttgg gatttatgaa ggaaagttgc  31980
aaactttctc aaattttacc atttttgctt tgatgtttgt ttagattgcg acagaacaaa  32040
ctcatatatg ttgaaatttt tgcttggttt tgtataggat tgtgtctttt gcttataaat  32100
gttgaaatct gaactttttt tttgtttggt ttctttgagc aggagataag gcgcaccacc  32160
atggcttcta catctgctgc tcaagacgct gctccttacg agttcccttc tctcactgag  32220
atcaagaggg ctcttccttc tgagtgtttc gaggcttctg ttcctctttc tctctactac  32280
accgctagat ctcttgctct tgctggatct ctcgctgttg ctctctctta cgctagagct  32340
ttgcctcttg ttcaggctaa cgctcttctt gatgctactc tctgcactgg atacgttctt  32400
ctccagggaa tcgttttctg ggattcttc accgttggtc acgattgtgg acacggagct  32460
ttctctagat ctcacgtgct caacttctct gttggaaccc tcatgcactc tatcatcctt  32520
accccttcg agtcttggaa gctctctcac agacaccacc acaagaacac cggaaacatc  32580
gataaggacg agatcttcta ccctcaaaga gaggctgatt ctcaccctgt ttctagacac  32640
cttgtgatgt ctcttggatc tgcttggttc gcttaccttt tcgctggatt ccctcctaga  32700
accatgaacc acttcaaccc ttgggaggct atgtatgtta gaagagtggc tgctgtgatc  32760
atctctctcg gagttctttt cgctttcgct ggactctact cttacctcac cttcgttctt  32820
ggattcacca ctatggctat ctactacttc ggacctctct tcatcttcgc taccatgctt  32880
gttgttacca ctttcctcca ccacaacgat gaggagacac cttggtacgc tgattctgag  32940
tggacttacg tgaagggaaa cctctcttct gtggacagat cttacggtgc tctcatcgac  33000
aaccttagcc acaacatcgg aactcaccag atccaccacc tcttccctat catccctcac  33060
tacaagctca acgatgctac tgctgctttc gctaaggctt tccctgagct tgttaggaaa  33120
aacgctgctc ctatcatccc aactttcttc aggatggctg ctatgtacgc taagtacgga  33180
gttgttgaca ctgatgctaa gaccttcact ctcaaggagg ctaaggctgc tgctaagact  33240
aagtcatctt gatgattaat gaaggccgca gatatcagat ctggtcgacc tagaggatcc  33300
ccggccgcaa agataataac aaaagcctac tatataacgt acatgcaagt attgtatgat  33360
attaatgttt ttacgtacgt gtaaacaaaa ataattacgt ttgtaacgta tggtgatgat  33420
gtggtgcact aggtgtaggc cttgtattaa taaaaagaag tttgttctat atagagtggt  33480
ttagtacgac gatttattta ctagtcggat tggaatagag aaccgaattc ttcaatcctt  33540
gcttttgatc aagaattgaa accgaatcaa atgtaaaagt tgatatattt gaaaaacgta  33600
ttgagcttat gaaaatgcta atactctcat ctgtatggaa aagtgacttt aaaaccgaac  33660
ttaaaagtga caaaagggga atatcgcatc aaaccgaatg aaaccgatct acgtaggctc  33720
agctgagctt acctaaggct acgtaggctc acgtgacgtt acgtaaggct acgtagcgtc  33780
acgtgagctt acctaactct agctagcctc acgtgacctt agctaacact aggtagcgtc  33840
agcttagcag atatttggtg tctaaatgtt tattttgtga tatgttcatg tttgaaatgg  33900
tggtttcgaa accagggaca acgttgggat ctgatagggt gtcaaagagt attatggatt  33960
gggacaattt cggtcatgag ttgcaaattc aagtatatcg ttcgattatg aaaattttcg  34020
aagaatatcc catttgagag agtctttacc tcattaatgt ttttagatta tgaaatttta  34080
tcatagttca tcgtagtctt tttggtgtaa aggctgtaaa aagaaattgt tcacttttgt  34140
tttcgtttat gtgaaggctg taaaagattg taaaagacta ttttggtgtt ttggataaaa  34200
tgatagtttt tatagattct tttgctttta gaagaaatac atttgaaatt ttttccatgt  34260
tgagtataaa ataccgaaat cgattgaaga tcatagaaat attttaactg aaaacaaatt  34320
tataactgat tcaattctct ccatttttat acctatttaa ccgtaatcga ttctaataga  34380
tgatcgattt tttatataat cctaattaac caacggcatg tattggataa ttaaccgatc  34440
aactctcacc cctaatagaa tcagtatttt ccttcgacgt taattgatcc tacactatgt  34500
aggtcatatc catcgtttta atttttggcc accattcaat tctgtcttgc ctttagggat  34560
gtgaatatga acggccaagg taagagaata aaaataatcc aaattaaagc aagagaggcc  34620
aagtaagata atccaaatgt acacttgtca ttgccaaaat tagtaaaata ctcggcatat  34680
tgtattccca cacattatta aaataccgta tatgtattgg ctgcatttgc atgaataata  34740
ctacgtgtaa gcccaaaaga acccacgtgt agcccatgca aagttaacac tcacgacccc  34800
attcctcagt ctccactata taaacccacc atccccaatc tcaccaaacc caccacacaa  34860
ctcacaactc actctcacac cttaaagaac caatcaccac caaaaaaagt tctttgcttt  34920
cgaagttgcc gcaacctaaa caggtttttc cttcttcttt cttcttatta actacgacct  34980
tgtcctttgc ctatgtaaaa ttactaggtt ttcatcagtt acactgatta agttcgttat  35040
agtggaagat aaaatgccct caaagcattt tgcaggatat ctttgatttt tcaaagatat  35100
ggaactgtag agtttgatag tgttcttgaa tgtggttgca tgaagttttt ttggtctgca  35160
tgttattttt tcctcgaaat atgttttgag tccaacaagt gattcacttg ggattcagaa  35220
agttgttttc tcaatatgta acagtttttt tctatggaga aaaatcatag ggaccgttgg  35280
ttttggcttc tttaattttg agctcagatt aaacccattt tacccggtgt tcttggcaga  35340
attgaaaaca gtacgtagta ccgcgcctac catgccacct agtgctgcta gtgaaggtgg  35400
tgttgctgaa cttagagctg ctgaagttgc tagctacact agaaaggctg ttgacgaaag  35460
acctgacctc actatagttg gtgacgctgt ttacgacgct aaggctttta gggacgagca  35520
ccctggtggt gctcacttcg ttagcctttt cggaggtagg gacgctactg aggcttttat  35580
ggaatatcac cgtagagctt ggcctaaggc taggatgtct aagttcttcg ttggttcact  35640
```

tgacgctagc gagaagccta ctcaagctga ttcagcttac cttagacttt gcgctgaggt 35700
taacgctctt ttgcctaagg gtagcggagg attcgctcct cctagctact ggcttaaggc 35760
tgctgctctt gttgttgctg ctgttagtat agagggttat atgctcctta ggggtaagac 35820
ccttttgctt agcgttttcc ttggactcgt gttcgcttgg ataggactta atattcagca 35880
cgacgctaat cacggtgctc ttagtagaca ctcagtgatt aactactgcc tcggttacgc 35940
tcaggattgg ataggtggta atatggtgct ttggcttcaa gagcacgttg tgatgcacca 36000
cctccacact aacgacgttg acgctgatcc tgatcaaaag gctcacggtg ttcttagact 36060
taagcctact gacggttgga tgccttggca cgcacttcaa caactctata tccttcctgg 36120
tgaggctatg tacgctttta agcttctttt cttggacgcc cttgagcttc ttgcttggag 36180
gtgggagggt gagaagatta gccctcttgc tagagctttg ttcgctcctg ctgttgcttg 36240
taagcttgga ttctgggcta gattcgttgc tctccctctc tggcttcaac ctactgttca 36300
cactgctttg tgtatctgtg ctactgtgtg tactggtagc ttctacctcg ccttcttctt 36360
ctttatctct cacaacttcg acggtgttgg tagcgttgga cctaagggat cacttcctag 36420
atcagctact ttcgttcaac gtcaggttga gactagctct aacgttggtg gttactggct 36480
tggagttctt aacggtggac ttaactttca gatagagcac cacttgttcc ctaggcttca 36540
ccactcttac tacgctcaaa tagctcctgt ggttaggact cacatagaga agctcggttt 36600
taagtaccgt cacttcccta ccgttggatc taaccttagc tcaatgcttc agcatatggg 36660
taagatggga actagacctg gtgctgagaa gggtggtaag gctgagtagt gattaatgaa 36720
taattgattg ctgctttaat gagatatgcg agacgcctat gatcgcatga tatttgcttt 36780
caattctgtt gtgcacgttg taaaaaacct gagcatgtgt agctcagatc cttaccgccg 36840
gtttcggttc attctaatga atatatcacc cgttactatc gtatttttat gaataatatt 36900
ctccgttcaa tttactgatt gtctacgtag cgtcacctga cgttacgtaa ggctacctag 36960
gctcacgtga cgttacgtaa cgctacgtag cgtcaggtga ggttagctaa cgctagctag 37020
cctcacctga cgttaggtaa ggctacgtag cgtcacctga gattagctaa gcctacctag 37080
actcacgtga ccttaggtaa cgctacgtag cgtcaaagct ttacaacgct acacaaaact 37140
tataaccgta atcaccattc attaacttaa ctactatcac atgcattcat gaattgaaac 37200
gagaaggatg taaatagttg ggaagttatc tccacgttga agagatcgtt agcgagagct 37260
gaaagaccga gggaggagac gccgtcaaca cggacagagt cgtcgaccct cacatgaagt 37320
aggaggaatc tccgtgagga gccagagaga cgtctttggt cttcggtttc gatccttgat 37380
ctgacggaga agacgagaga agtgcgactg gactccgtga ggaccaacag agtcgtcctc 37440
ggtttcgatc gtcggtattg gtggagaagg cggaggaatc tccgtgacga gccagagaga 37500
tgtcgtcggt cttcggtttc gatccttgat ctgacggaga agacgagaga agtgcgacga 37560
gactccgtga ggaccaacag agttgtcctc ggtttcgatc gtcggtttcg gcggagaagg 37620
cggaggaatc tccgtgagga gccagagaga cgtcgttggt cttcggtttc gatccttgat 37680
ctgttggaga agacgagaca agtgggacga gactcaacga cggagtcaga gacgtcgtcg 37740
gtcttcggtt tcggccgaga aggcggagtc ggtcttcggt ttcggccgag aaggcggagg 37800
agacgtcttc gatttgggtc tctcctcttg acgaagaaaa caaagaacac gagaaataat 37860
gagaaagaga acaaaagaaa aaaaaataaa aataaaaata aaatttggtc ctcttatgtg 37920
gtgacacgtg gtttgaaacc caccaaataa tcgatcacaa aaaacctaag ttaaggatcg 37980
gtaataacct ttctaattaa ttttgattta tattaaatca ctctttttat ttataaaccc 38040
cactaaatta tgcgatattg attgtctaag tacaaaaatt ctctcgaatt caatacacat 38100
gtttcatata tttagccctg ttcatttaat attactagcg catttttaat ttaaaatttt 38160
gtaaactttt ttggtcaaag aacatttttt taattagaga cagaaatcta gactctttat 38220
ttggaataat agtaataaag atatattagg caatgagttt atgatgttat gtttatatag 38280
tttatttcat tttaaattga aaagcattat ttttatcgaa atgaatctag tatacaatca 38340
atatttatgt tttttcatca gatactttcc tattttttgg cacctttcat cggactactg 38400
atttatttca atgtgtatgc atgcatgagc atgagtatac acatgtcttt taaaatgcat 38460
gtaaagcgta acggaccaca aaagaggatc catacaaata catctcatcg cttcctctac 38520
tattctccga cacacacact gagcatggtg cttaaacact ctggtgagtt ctagtacttc 38580
tgctatgatc gatctcatta ccatttctta aatttctctc cctaaatatt ccgagttctt 38640
gatttttgat aacttcaggt tttctctttt tgataaatct ggtctttcca ttttttttt 38700
tttgtggtta atttagtttc ctatgttctt cgattgtatt atgcatgatc tgtgtttgga 38760
ttctgttaga ttatgtattg gtgaatatgt atgtgttttt gcatgtctgg ttttggtctt 38820
aaaaatgttc aaatctgatg atttgattga agcttttta gtgttggttt gattcttctc 38880
aaaactactg ttaatttact atcatgtttt ccaactttga ttcatgatga cacttttgtt 38940
ctgctttgtt ataaaatttt ggttggtttg attttgtaat tatagtgtaa ttttgttagg 39000
aatgaacatg ttttaatact ctgttttcga tttgtcacac attcgaatta ttaatcgata 39060
atttaactga aaattcatgg ttctagatct tgttgtcatc agattatttg tttcgataat 39120
tcatcaaata tgtagtcctt ttgctgattt gcgactgttt cattttttct caaaattgtt 39180
ttttgttaag tttatctaac agttatcgtt gtcaaaagtc tctttcattt tgcaaaatct 39240
tctttttttt tttgtttgta actttgtttt ttaagctaca catttagtct gtaaaatagc 39300
atcgaggaac agttgtctta gtagacttgc atgttcttgt aacttctatt tgtttcagtt 39360
tgttgatgac tgctttgatt ttgtaggtca aaccgcgcca tgtctgctag cggagctttg 39420
ttgcctgcta tagctttcgc tgcttacgct tacgctacct acgcttatgc tttcgagtgg 39480
agccacgcta acggaatcga taacgtggat gctagagagt ggattggagc tttgtctttg 39540
agactccctg caattgcaac cacaatgtac ctcttgttct gccttgtggg acctagattg 39600
atggctaaga gggaggcttt tgatcctaag ggatttatgc tcgcttacaa cgcttaccaa 39660
accgctttca acgttgtggt gctcggaatg ttcgctagag agatctctgg attgggacaa 39720

cctgtttggg gatctactat gccttggagc gataggaagt ccttcaagat tttgttggga 39780
gtgtggctcc actacaacaa taagtacctc gagttgttgg atactgtgtt catggtggct 39840
aggaaaaaga ccaagcagct ctctttcttg cacgtgtacc accacgcttt gttgatttgg 39900
gcttggtggc ttgtttgtca cctcatggct accaacgatt gcatcgatgc ttatttcgga 39960
gctgcttgca actctttcat ccacatcgtg atgtactcct actacctcat gtctgctttg 40020
ggaattaggt gcccttggaa gagatatatc acccaggctc agatgttgca attcgtgatc 40080
gtgttcgctc acgctgtttt cgtgctcaga caaaagcact gccctgttac tttgccttgg 40140
gcacaaatgt tcgtgatgac aaatatgttg gtgctcttcg gaaacttcta cctcaaggct 40200
tactctaaca agtctagggg agatggagct tcttctgtta agcctgctga gactactaga 40260
gcaccttctg tgagaagaac caggtcaagg aagatcgatt gatagttaat gaactaagtt 40320
tgatgtatct gagtgccaac gtttactttg tctttccttt cttttattgg ttatgattag 40380
atgtttacta tgttctctct ttttcgttat aaataaagaa gttcaattct tctatagttt 40440
caaacgcgat tttaagcgtt tctatttagg tttacatgat ttcttttaca aaatcatctt 40500
taaaatacag tatattttta gttttcataa aatatttaaa gaaatgaaag tttataaaca 40560
ttcactccta ttctctaatt aaggatttgt aaaacaaaaa ttttgtaagc atatcgattt 40620
atgcgttttg tcttaattag ctcactaaat aataaataat agcttatgtt gtgggactgt 40680
ttaattacct aacttagaac taaaatcaac tctttgtgct agctagcctc agctgacgtt 40740
acgtaacgct aggtagcgtc acgtgacgtt agctaacgct aggtagcgtc agctgagctt 40800
acgtaagcgc ttaattaaag tactgatatc ggtaccaaat cgaatccaaa aattacggat 40860
atgaatatag gcatatccgt atccgaatta tccgtttgac agctagcaac gattgtacaa 40920
ttgcttcttt aaaaaaggaa gaaagaaaga aagaaaagaa tcaacatcag cgttaacaaa 40980
cggccccgtt acggcccaaa cggtcatata gagtaacggc gttaagcgtt gaaagactcc 41040
tatcgaaata cgtaaccgca aacgtgtcat agtcagatcc cctcttcctt caccgcctca 41100
aacacaaaaa taatcttcta cagcctatat atacaacccc cccttctatc tctcctttct 41160
cacaattcat catctttctt tctctacccc caattttaag aaatcctctc ttctcctctt 41220
cattttcaag gtaaatctct ctctctctct ctctctctgt tattccttgt tttaattagg 41280
tatgtattat tgctagtttg ttaatctgct tatcttatgt atgccttatg tgaatatctt 41340
tatcttgttc atctcatccg tttagaagct ataaatttgt tgatttgact gtgtatctac 41400
acgtggttat gtttatatct aatcagatat gaatttcttc atattgttgc gtttgtgtgt 41460
accaatccga aatcgttgat ttttttcatt taatcgtgta gctaattgta cgtatacata 41520
tggatctacg tatcaattgt tcatctgttt gtgtttgtat gtatacagat ctgaaaacat 41580
cacttctctc atctgattgt gttgttacat acatagatat agatctgtta tatcattttt 41640
tttattaatt gtgtatatat atatgtgcat agatctggat tacatgattg tgattattta 41700
catgattttg ttatttacgt atgtatatat gtagatctgg actttttgga gttgttgact 41760
tgattgtatt tgtgtgtgta tatgtgtgtt ctgatcttga tatgttatgt atgtgcagct 41820
gaaccatggc ggcggcaaca acaacaacaa caacatcttc ttcgatctcc ttctccacca 41880
aaccatctcc ttcctcctcc aaatcaccat taccaatctc cagattctcc ctcccattct 41940
ccctaaaccc caacaaatca tcctcctcct cccgccgccg cggtatcaaa tccagctctc 42000
cctcctccat ctccgccgtg ctcaacacaa ccaccaatgt cacaaccact ccctctccaa 42060
ccaaacctac caaacccgaa acattcatct cccgattcgc tccagatcaa ccccgcaaag 42120
gcgctgatat cctcgtcgag gctttagaac gtcaaggcgt agaaaccgta ttcgcttacc 42180
ctggaggtac atcaatggag attcaccaag ccttaacccg ctcttcctca atccgtaacg 42240
tccttcctcg tcacgaacaa ggaggtgtat tcgcagcaga aggatacgct cgatcctcag 42300
gtaaaccagg tatctgtata gccacttcag gtcccggagc tacaaatctc gttagcggat 42360
tagccgatgc gttgttagat agtgttcctc ttgtagcaat cacaggacaa gtccctcgtc 42420
gtatgattgg tacagatgcg tttcaagaga ctccgattgt tgaggtaacg cgttcgatta 42480
cgaagcataa ctatcttgtg atggatgttg aagatatccc aaggattatt gaagaggctt 42540
tctttttagc tacttctggt agacctggac ctgttttggt tgatgttcct aaagatattc 42600
aacaacagct tgcgattcct aattgggaac aggctatgag attacctggt tatatgtcta 42660
ggatgcctaa acctccggaa gattctcatt tggagcagat tgttaggttg atttctgagt 42720
ctaagaagcc tgtgttgtat gttggtggtg gttgtcttaa ttctagcgat gaattgggta 42780
ggtttgttga gcttacgggc atccctgttg cgagtacgtt gatggggctg ggatcttatc 42840
cttgtgatga tgagttgtcg ttacatatgc ttggaatgca tgggactgtg tatgcaaatt 42900
acgctgtgga gcatagtgat ttgttgttgg cgtttggggt aaggtttgat gatcgtgtca 42960
cgggtaaact tgaggctttt gctagtaggg ctaagattgt tcatattgat attgactcgg 43020
ctgagattgg gaagaataag actcctcatg tgtctgtgtg tggtgatgtt aagctggctt 43080
tgcaagggat gaataaggtt cttgagaacc gagcggagga gcttaaactt gattttggag 43140
tttggaggaa tgagttgaac gtacagaaac agaagtttcc gttgagcttt aagacgtttg 43200
gggaagctat tcctccacag tatgcgatta aggtccttga tgagttgact gatggaaaag 43260
ccataataag tactggtgtc gggcaacatc aaatgtgggc ggcgcagttc tacaattaca 43320
agaaaccaag gcagtggcta tcatcaggag gccttggagc tatgggattt ggacttcctg 43380
ctgcgattgg agcgtctgtt gctaaccctg atgcgatagt tgtggatatt gacggagatg 43440
gaagttttat aatgaatgtg caagagctag ccactattcg tgtagagaat cttccagtga 43500
aggtactttt attaaacaac cagcatcttg gcatggttat gcaatgggaa gatcggttct 43560
acaaagctaa ccgagctcac acatttctcg ggacccggc tcaggaggac gagatattcc 43620
cgaacatgtt gctgtttgca gcagcttgcg ggattccagc ggcgagggtg acaaagaaag 43680
cagatctccg agaagctatt cagacaatgc tggatacacc aggaccttac ctgttggatg 43740
tgatttgtcc gcaccaagaa catgtgttgc cgatgatccc gaatggtggc actttcaacg 43800

atgtcataac ggaaggagat ggccggatta aatactgaga gatgaaaccg gtgattatca 43860
gaacctttta tggtctttgt atgcatatgg taaaaaaact tagtttgcaa tttcctgttt 43920
gttttggtaa tttgagtttc ttttagttgt tgatctgcct gctttttggt ttacgtcaga 43980
ctactactgc tgttgttgtt tggtttcctt tctttcattt tataaataaa taatccggtt 44040
cggtttactc cttgtgactg gctcagtttg gttattgcga aatgcgaatg gtaaattgag 44100
taattgaaat tcgttattag ggttctaagc tgttttaaca gtcactgggt taatatctct 44160
cgaatcttgc atggaaaatg ctcttaccat tggtttttaa ttgaaatgtg ctcatatggg 44220
ccgtggtttc caaattaaat aaaactacga tgtcatcgag aagtaaaatc aactgtgtcc 44280
acattatcag ttttgtgtat acgatgaaat agggtaattc aaaatctagc ttgatatgcc 44340
ttttggttca ttttaacctt ctgtaaacat tttttcagat tttgaacaag taaatccaaa 44400
aaaaaaaaaa aaaatctcaa ctcaacacta aattatttta atgtataaaa gatgcttaaa 44460
acatttggct taaaagaaag aagctaaaaa catagagaac tcttgtaaat tgaagtatga 44520
aaatatactg aattgggtat tatatgaatt tttctgattt aggattcaca tgatccaaaa 44580
aggaaatcca gaagcactaa tcagacattg gaagtaggat taatcagtga tcagtaacta 44640
ttaaattcaa ttaaccgcgg acatctacat ttttgaattg aaaaaaaatt ggtaattact 44700
ctttcttttt ctccatattg accatcatac tcattgtaag acacacagat gaagaagtca 44760
aatagctcga cattcctttg gtctggtcca gtgatgtcga ctcacaaagc gaagattgca 44820
tgaatagact atcatgtgtt tgctatgtat gagtactatg gaatcgaggg atcatttatt 44880
tttcatgtca ttgttcttgg aggttgtgtg gagaggcatc accattaatc ttctgaacat 44940
cagctatact aatcattaat tggaatcagc gactgcaaat tatggcagag gatgttggaa 45000
atagtaccac cacattccta atccactatg ctttccaagc tgcagtaatt tgagttggag 45060
acgggagttt tgctcattta ctcaggctct tggacaaaca aatgtgaaat cgcatatctg 45120
ctcaatccga catactaatc aaaggtcaag aatttttttt agagaagatg aaaaccataa 45180
tgaaagcatc taatgtttat agaaaattac caaaaatacc acatttatga aaaattatca 45240
aaaatacaat attcatagta tcacttttca tatttacaat aaccacgttt gttctcaatt 45300
ttaacgaaga acaaacgaca tttataatcc taagataatt ttttctaatt caaaaataat 45360
tttcgatttt caaaaaaaaa attgaaaaaa aaattgaaaa gaaaaattca aaacaaaatt 45420
atatgaaagt tcaaatttga aaaatgataa ttcaaaaaca taaaaaaaata tatttttatt 45480
taaataatta tttattatat atatatagac catggagcaa gggggcgtgg gccccggggc 45540
ccaaactttt tttcccatat ataatgtcaa caaggacccg atttttagaa aaaaaaatag 45600
gtataaagga gtccaaaaaa ttcaaattag ttatatatgt atgtaaaaaa atattaaaat 45660
ttattttgcc caagggccta tagattcatt gggccgaccc tggggttggg gttgtgtgtg 45720
tgtcattcta taattaaccg gcaaaaactc caaaattttt atttaacaaa tgtataa 45777

<210> 299
<211> 43720
<212> DNA
<213> Artificial sequence

<220>
<223> T-DNA insertion in LBFDAU Locus 1, including left and right border sequences

<400> 299
cagtcagcat catcacacca aaagttaggc ccgaatagtt tgaaattaga aagctcgcaa 60
ttgaggtcta caggccaaat tcgctcttag ccgtacaata ttactcaccg gtgcgatgcc 120
ccccatcgta ggtgaaggtg gaaattaatg gcgcgcctga tcactgatta gtaactatta 180
cgtaagccta cgtagcgtca cgtgacgtta gctaacgcta cgtagcctca gctgacgtta 240
cgtaagccta cgtagcgtca cgtgagctta gctaacgcta cctaggctca gctgacgtta 300
cgtaacgcta gctagcgtca ctcctgcagc aaatttacac attgccacta aacgtctaaa 360
cccttgtaat ttgtttttgt tttactatgt gtgttatgta tttgatttgc gataaatttt 420
tatatttggt actaaattta taacaccttt tatgctaacg tttgccaaca cttagcaatt 480
tgcaagttga ttaattgatt ctaaattatt tttgtcttct aaatacatat actaatcaac 540
tggaaatgta aatatttgct aatatttcta ctataggaga attaaagtga gtgaatatgg 600
taccacaagg tttggagatt taattgttgc aatgctgcat ggatggcata tacaccaaac 660
attcaataat tcttgaggat aataatggta ccacacaaga tttgaggtgc atgaacgtca 720
cgtggacaaa aggtttagta atttttcaag acaacaatgt taccacacac aagttttgag 780
gtgcatgcat ggatgccctg tggaaagttt aaaaatattt tggaaatgat ttgcatggaa 840
gccatgtgta aaaccatgac atccacttgg aggatgcaat aatgaagaaa actacaaatt 900
tacatgcaac tagttatgca tgtagtctat ataatgagga ttttgcaata ctttcattca 960
tacacactca ctaagtttta cacgattata atttcttcat agccagtact gtttaagctt 1020
cactgtctct gaatcggcaa aggtaaacgt atcaattatt ctacaaaccc ttttattttt 1080
cttttgaatt accgtcttca ttggttatat gataacttga taagtaaagc ttcaataatt 1140
gaatttgatc tgtgtttttt tggccttaat actaaatcct tacataagct ttgttgcttc 1200
tcctcttgtg agttgagtgt taagttgtaa taatggttca ctttcagctt tagaagaaac 1260
catggaagtt gttgagaggt tctacggaga gttggatgga aaggtttccc aaggagtgaa 1320
cgctttgttg ggatctttcg gagttgagtt gactgatacc ccaactacta agggattgcc 1380
actcgttgat tctccaactc caattgtgtt gggagtgtct gtttacttga ccatcgtgat 1440

cggaggattg ctttggatca aggctagaga tctcaagcca agagcttctg agccattctt 1500
gttgcaagct ttggtgttgg tgcacaactt gttctgcttc gctttgtctc tttacatgtg 1560
cgtgggtatc gcttaccaag ctatcacctg gagatattcc ttgtggggaa acgcttataa 1620
cccaaagcac aaggagatgg ctatcctcgt ttacctcttc tacatgtcca agtacgtgga 1680
gttcatggat accgtgatca tgatcctcaa gagatccacc agacagattt ctttcctcca 1740
cgtgtaccac cactcttcta tctcccttat ctggtgggct attgctcacc acgctccagg 1800
aggagaggct tattggagtg ctgctctcaa ctctggagtg cacgtgttga tgtacgctta 1860
ctacttcttg gctgcttgct tgagatcttc cccaaagctc aagaacaagt acctcttctg 1920
gggaagatac ctcacccaat tccagatgtt ccagttcatg ctcaacttgg tgcaagctta 1980
ctacgatatg aaaaccaacg ctccatatcc acaatggctc atcaagatcc tcttctacta 2040
catgatctcc ctcttgttcc tcttcggaaa cttctacgtg caaaagtaca tcaagccatc 2100
cgatggaaag caaaagggag ctaagaccga gtgatcgaca agctcgagtt tctccataat 2160
aatgtgtgag tagttcccag ataagggaat tagggttcct atagggtttc gctcatgtgt 2220
tgagcatata agaaaccctt agtatgtatt tgtatttgta aaatacttct atcaataaaa 2280
tttctaattc ctaaaaccaa aatccagtac taaaatccag atcccccgaa ttaattcggc 2340
gttaattcag ctagctagcc tcagctgacg ttacgtaacg ctaggtagcg tcacgtgacg 2400
ttagctaacg ctaggtagcg tcagctgagc ttacgtaagc gcttagcaga tatttggtgt 2460
ctaaatgttt attttgtgat atgttcatgt ttgaaatggt ggtttcgaaa ccagggacaa 2520
cgttgggatc tgatagggtg tcaaagagta ttatggattg ggacaatttc ggtcatgagt 2580
tgcaaattca agtatatcgt tcgattatga aaattttcga agaatatccc atttgagaga 2640
gtctttacct cattaatgtt tttagattat gaaattttat catagttcat cgtagtcttt 2700
ttggtgtaaa ggctgtaaaa agaaattgtt cacttttgtt ttcgtttatg tgaaggctgt 2760
aaaagattgt aaaagactat tttggtgttt tggataaaat gatagttttt atagattctt 2820
ttgcttttag aagaaataca tttgaaattt tttccatgtt gagtataaaa taccgaaatc 2880
gattgaagat catagaaata ttttaactga aaacaaattt ataactgatt caattctctc 2940
catttttata cctatttaac cgtaatcgat tctaatagat gatcgatttt ttatataatc 3000
ctaattaacc aacggcatgt attggataat taaccgatca actctcaccc ctaatagaat 3060
cagtattttc cttcgacgtt aattgatcct acactatgta ggtcatatcc atcgttttaa 3120
tttttggcca ccattcaatt ctgtcttgcc tttagggatg tgaatatgaa cggccaaggt 3180
aagagaataa aaataatcca aattaaagca agagaggcca agtaagataa tccaaatgta 3240
cacttgtcat tgccaaaatt agtaaaatac tcggcatatt gtattcccac acattattaa 3300
aataccgtat atgtattggc tgcatttgca tgaataatac tacgtgtaag cccaaaagaa 3360
cccacgtgta gcccatgcaa agttaacact cacgacccca ttcctcagtc tccactatat 3420
aaacccacca tccccaatct caccaaaccc accacacaac tcacaactca ctctcacacc 3480
ttaaagaacc aatcaccacc aaaaaatttc acgatttgga atttgattcc tgcgatcaca 3540
ggtatgacag gttagatttt gttttgtata gttgtataca tacttctttg tgatgttttg 3600
tttacttaat cgaattttg gagtgtttta aggtctctcg tttagaaatc gtggaaaata 3660
tcactgtgtg tgtgttctta tgattcacag tgtttatggg tttcatgttc tttgttttat 3720
cattgaatgg gaagaaattt cgttgggata caaatttctc atgttcttac tgatcgttat 3780
taggagtttg gggaaaaagg aagagttttt ttggttggtt cgagtgatta tgaggttatt 3840
tctgtatttg atttatgagt taatggtcgt tttaatgttg tagaccatgg gaaaaggatc 3900
tgagggaaga tctgctgcta gagagatgac tgctgaggct aacggagata agagaaagac 3960
catcctcatt gagggagtgt tgtacgatgc taccaacttc aaacacccag gaggttccat 4020
tattaacttc ctcaccgagg gagaagctgg agttgatgct acccaagctt acagagagtt 4080
ccatcagaga tccggaaagg ctgataagta cctcaagtcc ctcccaaagt tggatgcttc 4140
taaggtggag tctaggttct ctgctaagga gcaggctaga agggacgcta tgaccaggga 4200
ttacgctgct ttcagagagg agttggttgc tgagggatac ttcgatccat ctatcccaca 4260
catgatctac agagtggtgg agattgtggc tttgttcgct ttgtctttct ggttgatgtc 4320
taaggcttct ccaacctctt tggttttggg agtggtgatg aacggaatcg ctcaaggaag 4380
atgcggatgg gttatgcacg agatgggaca cggatctttc actggagtta tctggctcga 4440
tgataggatg tgcgagttct tctacggagt tggatgtgga atgtctggac actactggaa 4500
gaaccagcac tctaagcacc acgctgctcc aaacagattg gagcacgatg tggatttgaa 4560
caccttgcca ctcgttgctt tcaacgagag agttgtgagg aaggttaagc caggatcttt 4620
gttggctttg tggctcagag ttcaggctta tttgttcgct ccagtgtctt gcttgttgat 4680
cggattggga tggaccttgt acttgcaccc aagatatatg ctcaggacca agagacacat 4740
ggagtttgtg tggatcttcg ctagatatat cggatggttc tccttgatgg gagctttggg 4800
atattctcct ggaacttctg tgggaatgta cctctgctct ttcggacttg gatgcatcta 4860
catcttcctc caattcgctg tgtctcacac ccacttgcca gttaccaacc cagaggatca 4920
attgcactgg cttgagtacg ctgctgatca caccgtgaac atctctacca agtcttggtt 4980
ggttacctgg tggatgtcta acctcaactt ccaaatcgag caccacttgt tcccaaccgc 5040
tccacaattc aggttcaagg agatctctcc aagagttgag gctctcttca agagacacaa 5100
cctcccttac tacgatttgc catacacctc tgctgtttct actaccttcg ctaacctcta 5160
ctctgttgga cactctgttg gagctgatac caagaagcag gattgactgc tttaatgaga 5220
tatgcgagac gcctatgatc gcatgatatt tgctttcaat tctgttgtgc acgttgtaaa 5280
aaacctgagc atgtgtagct cagatcctta ccgccggttt cggttcattc taatgaatat 5340
atcacccgtt actatcgtat ttttatgaat aatattctcc gttcaattta ctgattgtct 5400
acgtaggctc agctgagctt acctaaggct acgtaggctc acgtgacgtt acgtaaggct 5460
acgtagcgtc acgtgagctt acctaactct agctagcctc acgtgacctt agctaacact 5520

aggtagcgtc agctcgacgg cccggactgt atccaacttc tgatctttga atctctctgt 5580
tccaacatgt tctgaaggag ttctaagact tttcagaaag cttgtaacat gctttgtaga 5640
ctttctttga attactcttg caaactctga ttgaacctac gtgaaaactg ctccagaagt 5700
tctaaccaaa ttccgtcttg ggaaggccca aaatttattg agtacttcag tttcatggac 5760
gtgtcttcaa agatttataa cttgaaatcc catcattttt aagagaagtt ctgttccgca 5820
atgtcttaga tctcattgaa atctacaact cttgtgtcag aagttcttcc agaatcaact 5880
tgcatcatgg tgaaaatctg gccagaagtt ctgaacttgt catatttctt aacagttaga 5940
aaaatttcta agtgtttaga attttgactt ttccaaagca aacttgactt ttgactttct 6000
taataaaaca aacttcatat tctaacatgt cttgatgaaa tgtgattctt gaaatttgat 6060
gttgatgcaa aagtcaaagt ttgacttttc agtgtgcaat tgaccatttt gctcttgtgc 6120
caattccaaa cctaaattga tgtatcagtg ctgcaaactt gatgtcatgg aagatcttat 6180
gagaaaattc ttgaagactg agaggaaaaa ttttgtagta caacacaaag aatcctgttt 6240
ttcatagtcg gactagacac attaacataa aacaccactt cattcgaaga gtgattgaag 6300
aaggaaatgt gcagttacct ttctgcagtt cataagagca acttacagac actttacta 6360
aaatactaca aagaggaaga ttttaacaac ttagagaagt aatgggagtt aaagagcaac 6420
acattaaggg ggagtgttaa aattaatgtg ttgtaaccac cactaccttt agtaagtatt 6480
ataagaaaat tgtaatcatc acattataat tattgtcctt atttaaaatt atgataaagt 6540
tgtatcatta agattgagaa aaccaaatag tcctcgtctt gatttttgaa ttattgtttt 6600
ctatgttact tttcttcaag cctatataaa aactttgtaa tgctaaattg tatgctggaa 6660
aaaaatgtgt aatgaattga atagaaatta tggtatttca aagtccaaaa tccatcaata 6720
gaaatttagt acaaaacgta actcaaaaat attctcttat tttaaatttt acaacaatat 6780
aaaaatattc tcttatttta aattttacaa taatataatt tatcacctgt cacctttaga 6840
ataccaccaa caatattaat acttagatat tttattctta ataattttga gatctctcaa 6900
tatatctgat atttatttta tatttgtgtc atattttctt atgttttaga gttaaccctt 6960
atatcttggt caaactagta attcaatata tgagtttgtg aaggacacat tgacatcttg 7020
aaacattggt tttaaccttg ttggaatgtt aaaggtaata aaacattcag aattatgacc 7080
atctattaat atacttcctt tgtcttttaa aaaagtgtgc atgaaaatgc tctatggtaa 7140
gctagagtgt cttgctggcc tgtgtatatc aattccattt ccagatggta gaaactgcca 7200
ctacgaataa ttagtcataa gacacgtatg ttaacacacg tccccttgca tgttttttgc 7260
catatattcc gtctctttct ttttcttcac gtataaaaca atgaactaat taatagagcg 7320
atcaagctga acagttcttt gctttcgaag ttgccgcaac ctaaacaggt ttttccttct 7380
tctttcttct tattaactac gaccttgtcc tttgcctatg taaaattact aggttttcat 7440
cagttacact gattaagttc gttatagtgg aagataaaat gccctcaaag cattttgcag 7500
gatatctttg atttttcaaa gatatggaac tgtagagttt gatagtgttc ttgaatgtgg 7560
ttgcatgaag ttttttttggt ctgcatgtta ttttttcctc gaaatatgtt ttgagtccaa 7620
caagtgattc acttgggatt cagaaagttg ttttctcaat atgtaacagt ttttttctat 7680
ggagaaaaat catagggacc gttggttttg gcttctttaa ttttgagctc agattaaacc 7740
cattttaccc ggtgttcttg gcagaattga aaacagtacg tagtaccgcg cctaccatgt 7800
gtgttgagac cgagaacaac gatggaatcc ctactgtgga gatcgctttc gatggagaga 7860
gagaaagagc tgaggctaac gtgaagttgt ctgctgagaa gatggaacct gctgctttgg 7920
ctaagacctt cgctagaaga tacgtggtta tcgagggagt tgagtacgat gtgaccgatt 7980
tcaaacatcc tggaggaacc gtgattttct acgctctctc taacactgga gctgatgcta 8040
ctgaggcttt caaggagttc caccacagat ctagaaaggc taggaaggct ttggctgctt 8100
tgccttctag acctgctaag accgctaaag tggatgatgc tgagatgctc caggatttcg 8160
ctaagtggag aaaggagttg gagagggacg gattcttcaa gccttctcct gctcatgttg 8220
cttacagatt cgctgagttg gctgctatgt acgctttggg aacctacttg atgtacgcta 8280
gatacgttgt gtcctctgtg ttggtttacg cttgcttctt cggagctaga tgtggatggg 8340
ttcaacacga gggaggacac tcttctttga ccggaaacat ctggtgggat aagagaatcc 8400
aagctttcac tgctggattc ggattggctg gatctggaga tatgtggaac tccatgcaca 8460
acaagcacca cgctactcct caaaaagtga ggcacgatat ggatttggat accactcctg 8520
ctgttgcttt cttcaacacc gctgtggagg ataatagacc taggggattc tctaagtact 8580
ggctcagatt gcaagcttgg accttcattc ctgtgacttc tggattggtg ttgctcttct 8640
ggatgttctt cctccaccct tctaaggctt tgaagggagg aaagtacgag gagcttgtgt 8700
ggatgttggc tgctcacgtg attagaacct ggaccattaa ggctgttact ggattcaccg 8760
ctatgcaatc ctacggactc ttcttggcta cttcttgggt ttccggatgc tacttgttcg 8820
ctcacttctc tacttctcac acccacttgg atgttgttcc tgctgatgag cacttgtctt 8880
gggttaggta cgctgtggat cacaccattg atatcgatcc ttctcaggga tgggttaact 8940
ggttgatggg atacttgaac tgccaagtga ttcaccacct cttccccttct atgcctcaat 9000
tcagacaacc tgaggtgtcc agaagattcg ttgctttcgc taagaagtgg aacctcaact 9060
acaaggtgat gacttatgct ggagcttgga aggctacttt gggaaacctc gataatgtgg 9120
gaaagcacta ctacgtgcac ggacaacact ctggaaagac cgcttgatta atgaaggccg 9180
cctcgaccgt accccctgca gatagactat actatgtttt agcctgcctg ctggctagct 9240
actatgttat gttatgttgt aaaataaaca cctgctaagg tatatctatc tatattttag 9300
catggctttc tcaataaatt gtctttcctt atcgtttact atcttatacc taataatgaa 9360
ataataatat cacatatgag gaacggggca ggtttaggca tatatatacg agtgtagggc 9420
ggagtggggc tacgtagcgt cacgtgacgt tacctaagcc taggtagcct cagctgacgt 9480
tacgtaacgc taggtaggct cagctgacac gggcaggaca tagggactac tacaagcata 9540
gtatgcttca gacaaagagc taggaaagaa ctcttgatgg aggttaagag aaaaaagtgc 9600

tagaggggca tagtaatcaa acttgtcaaa accgtcatca tgatgaggga tgacataata 9660
taaaaagttg actaaggtct tggtagtact ctttgattag tattatatat tggtgagaac 9720
atgagtcaag aggagacaag aaaccgagga accatagttt agcaacaaga tggaagttgc 9780
aaagttgagc tagccgctcg attagttaca tctcctaagc agtactacaa ggaatggtct 9840
ctatactttc atgtttagca catggtagtg cggattgaca agttagaaac agtgcttagg 9900
agacaaagag tcagtaaagg tattgaaaga gtgaagttga tgctcgacag gtcaggagaa 9960
gtccctccgc cagatggtga ctaccaaggg gttggtatca gctgagaccc aaataagatt 10020
cttcggttga accagtggtt cgaccgagac tcttagggtg ggatttcact gtaagatttg 10080
tgcattttgt tgaatataaa ttgacaattt tttttattta attatagatt atttagaatg 10140
aattacatat ttagtttcta acaaggatag caatggatgg gtatgggtac aggttaaaca 10200
tatctattac ccacccatct agtcgtcggg ttttacacgt acccacccgt ttacataaac 10260
cagaccggaa ttttaaaccg tacccgtccg ttagcgggtt tcagatttac ccgtttaatc 10320
gggtaaaacc tgattactaa atatatattt tttatttgat aaacaaaaca aaaatgttaa 10380
tattttcata ttggatgcaa ttttaagaaa cacatattca taaatttcca tatttgtagg 10440
aaaataaaaa gaaaaatata ttcaagaaca caaatttcac cgacatgact tttattacag 10500
agttggaatt agatctaaca attgaaaaat taaaattaag atagaatatg ttgaggaaca 10560
tgacatagta taatgctggg ttacccgtcg ggtaggtatc gaggcggata ctactaaatc 10620
catcccactc gctatccgat aatcactggt ttcgggtata cccattcccg tcaacaggcc 10680
tttttaaccg gataatttca acttatagtg aatgaatttt gaataaatag ttagaatacc 10740
aaaatcctgg attgcatttg caatcaaatt ttgtgaaccg ttaaattttg catgtacttg 10800
ggatagatat aatagaaccg aattttcatt agtttaattt ataacttact ttgttcaaag 10860
aaaaaaaata tctatccaat ttacttataa taaaaaataa tctatccaag ttacttatta 10920
taatcaactt gtaaaaaggt aagaatacaa atgtggtagc gtacgtgtga ttatatgtga 10980
cgaaatgtta tatctaacaa aagtccaaat tcccatggta aaaaaaatca aaatgcatgg 11040
caggctgttt gtaaccttgg aataagatgt tggccaattc tggagccgcc acgtacgcaa 11100
gactcagggc cacgttctct tcatgcaagg atagtagaac accactccac ccacctccta 11160
tattagacct ttgcccaacc ctccccaact ttcccatccc atccacaaag aaaccgacat 11220
ttttatcata aatctggtgc ttaaacactc tggtgagttc tagtacttct gctatgatcg 11280
atctcattac catttcttaa atttctctcc ctaaatattc cgagttcttg atttttgata 11340
acttcaggtt ttctcttttt gataaatctg gtctttccat tttttttttt tgtggttaat 11400
ttagtttcct atgttcttcg attgtattat gcatgatctg tgtttggatt ctgttagatt 11460
atgtattggt gaatatgtat gtgtttttgc atgtctggtt ttggtcttaa aaatgttcaa 11520
atctgatgat ttgattgaag ctttttttagt gttggtttga ttcttctcaa aactactgtt 11580
aatttactat catgttttcc aactttgatt catgatgaca cttttgttct gctttgttat 11640
aaaattttgg ttggtttgat tttgtaatta tagtgtaatt ttgttaggaa tgaacatgtt 11700
ttaatactct gttttcgatt tgtcacacat tcgaattatt aatcgataat ttaactgaaa 11760
attcatggtt ctagatcttg ttgtcatcag attatttgtt tcgataattc atcaaatatg 11820
tagtcctttt gctgatttgc gactgtttca ttttttctca aaattgtttt ttgttaagtt 11880
tatctaacag ttatcgttgt caaaagtctc tttcatttttg caaaatcttc tttttttttt 11940
tgtttgtaac tttgtttttt aagctacaca tttagtctgt aaaatagcat cgaggaacag 12000
ttgtcttagt agacttgcat gttcttgtaa cttctatttg tttcagtttg ttgatgactg 12060
ctttgatttt gtaggtcaaa ggcgcaccct accatggatg cttataacgc tgctatggat 12120
aagattggag ctgctatcat cgattggagt gatccagatg gaaagttcag agctgatagg 12180
gaggattggt ggttgtgcga tttcagatcc gctatcacca ttgctctcat ctacatcgct 12240
ttcgtgatct tgggatctgc tgtgatgcaa tctctcccag ctatggaccc ataccctatc 12300
aagttcctct acaacgtgtc tcaaatcttc ctctgcgctt acatgactgt tgaggctgga 12360
ttcctcgctt ataggaacgg atacaccgtt atgccatgca accacttcaa cgtgaacgat 12420
ccaccagttg ctaacttgct ctggctcttc tacatctcca aagtgtggga tttctgggat 12480
accatcttca ttgtgctcgg aaagaagtgg agacaactct ctttcttgca cgtgtaccac 12540
cacaccacca tcttcctctt ctactggttg aacgctaacg tgctctacga tggagatatc 12600
ttcttgacca tcctcctcaa cggattcatt cacaccgtga tgtacaccta ctacttcatc 12660
tgcatgcaca ccaaggattc taagaccgga aagtctttgc caatctggtg gaagtcatct 12720
ttgaccgctt tccaactctt gcaattcacc atcatgatgt cccaagctac ctacttggtt 12780
ttccacggat gcgataaggt ttccctcaga atcaccatcg tgtacttcgt gtacattctc 12840
tccctttttct tcctcttcgc tcagttcttc gtgcaatcct acatggctcc aaagaagaag 12900
aagtccgctt gatgttaatg aaggccgcag atatcagatc tggtcgacct agaggatccc 12960
cggccgcaaa gataataaca aaagcctact atataacgta catgcaagta ttgtatgata 13020
ttaatgtttt tacgtacgtg taaacaaaaa taattacgtt tgtaacgtat ggtgatgatg 13080
tggtgcacta ggtgtaggcc ttgtattaat aaaaagaagt ttgttctata tagagtggtt 13140
tagtacgacg atttatttac tagtcggatt ggaatagaga accgaattct tcaatccttg 13200
cttttgatca agaattgaaa ccgaatcaaa tgtaaaagtt gatatatttg aaaaacgtat 13260
tgagcttatg aaaatgctaa tactctcatc tgtatggaaa agtgacttta aaaccgaact 13320
taaaagtgac aaaaggggaa tatcgcatca aaccgaatga aaccgatcta cgtaggctca 13380
gctgagctta gctaagccta cctagcctca cgtgagatta tgtaaggcta ggtagcgtca 13440
cgtgacgtta cctaacacta gctagcgtca gctgagctta gctaacccta cgtagcctca 13500
cgtgagctta cctaacgcta cgtagcctca cgtgactaag gatgacctac ccattcttga 13560
gacaaatgtt acattttagt atcagagtaa aatgtgtacc tataactcaa attcgattga 13620
catgtatcca ttcaacataa aattaaacca gcctgcacct gcatccacat ttcaagtatt 13680

ttcaaaccgt tcggctccta tccaccgggt gtaacaagac ggattccgaa tttggaagat 13740
tttgactcaa attcccaatt tatattgacc gtgactaaat caactttaac ttctataatt 13800
ctgattaagc tcccaattta tattcccaac ggcactacct ccaaaattta tagactctca 13860
tccccttttta aaccaactta gtaaacgttt tttttttaat tttatgaagt taagttttta 13920
ccttgttttt aaaaagaatc gttcataaga tgccatgcca gaacattagc tacacgttac 13980
acatagcatg cagccgcgga gaattgtttt tcttcgccac ttgtcactcc cttcaaacac 14040
ctaagagctt ctctctcaca gcacacacat acaatcacat gcgtgcatgc attattacac 14100
gtgatcgcca tgcaaatctc ctttatagcc tataaattaa ctcatcggct tcactcttta 14160
ctcaaaccaa aactcatcaa tacaaacaag attaaaaaca tttcacgatt tggaatttga 14220
ttcctgcgat cacaggtatg acaggttaga ttttgttttg tatagttgta tacatacttc 14280
tttgtgatgt tttgtttact taatcgaatt tttggagtgt tttaaggtct ctcgtttaga 14340
aatcgtggaa aatatcactg tgtgtgtgtt cttatgattc acagtgttta tgggtttcat 14400
gttctttgtt ttatcattga atgggaagaa atttcgttgg gatacaaatt tctcatgttc 14460
ttactgatcg ttattaggag tttggggaaa aaggaagagt ttttttggtt ggttcgagtg 14520
attatgaggt tatttctgta tttgatttat gagttaatgg tcgttttaat gttgtagacc 14580
gccatggcta ttttgaaccc tgaggctgat tctgctgcta acctcgctac tgattctgag 14640
gctaagcaaa gacaattggc tgaggctgga tacactcacg ttgagggtgc tcctgctcct 14700
ttgcctttgg agttgcctca cttctctctc agagatctca gagctgctat tcctaagcac 14760
tgcttcgaga gatctttcgt gacctccacc tactacatga tcaagaacgt gttgacttgc 14820
gctgctttgt tctacgctgc taccttcatt gatagagctg gagctgctgc ttatgttttg 14880
tggcctgtgt actggttctt ccagggatct tacttgactg gagtgtgggt tatcgctcac 14940
gagtgtggac accaggctta ttgctcttct gaggtggtga acaacttgat tggactcgtg 15000
ttgcactctg ctttgttggt gccttaccac tcttggagaa tctctcacag aaagcaccac 15060
tccaacactg gatcttgcga gaacgatgag gttttcgttc ctgtgaccag atctgtgttg 15120
gcttcttctt ggaacgagac cttggaggat tctcctctct accaactcta ccgtatcgtg 15180
tacatgttgg ttgttggatg gatgcctgga tacctcttct tcaacgctac tggacctact 15240
aagtactggg gaaagtctag gtctcacttc aacccttact ccgctatcta tgctgatagg 15300
gagaggtgga tgatcgtgct ctccgatatt ttcttggtgg ctatgttggc tgttttggct 15360
gctttggtgc acactttctc cttcaacacg atggtgaagt tctacgtggt gccttacttc 15420
attgtgaacg cttacttggt gttgattacc tacctccaac acaccgatac ctacatccct 15480
cacttcagag agggagagtg gaattggttg agaggagctt tgtgcactgt ggatagatca 15540
tttggtccat tcctcgattc tgtggtgcat agaatcgtgg atacccacgt ttgccaccat 15600
atcttctcca agatgccttt ctatcactgc gaggaggcta ccaacgctat taagcctctc 15660
ctcggaaagt tctacttgaa ggatactact cctgttcctg ttgctctctg gagatcttac 15720
acccactgca agttcgttga ggatgatgga aaggtggtgt tctacaagaa caagttatag 15780
ttaatgaata attgattggt tcgagtatta tggcattggg aaaactgttt ttcttgtacc 15840
atttgttgtg cttgtaattt actgtgtttt ttattcggtt ttcgctatcg aactgtgaaa 15900
tggaaatgga tggagaagag ttaatgaatg atatggtcct tttgttcatt ctcaaattaa 15960
tattatttgt tttttctctt atttgttgtg tgttgaattt gaaattataa gagatatgca 16020
aacattttgt tttgagtaaa aatgtgtcaa atcgtggcct ctaatgaccg aagttaatat 16080
gaggagtaaa acacttgtag ttgtaccatt atgcttattc actaggcaac aaatatattt 16140
tcagacctag aaaagctgca aatgttactg aatacaagta tgtcctcttg tgttttagac 16200
atttatgaac tttcctttat gtaattttcc agaatccttg tcagattcta atcattgctt 16260
tataattata gttatactca tggatttgta gttgagtatg aaaatatttt ttaatgcatt 16320
ttatgacttg ccaattgatt gacaacatgc atcaatctag ctagcctcag ctgacgttac 16380
gtaacgctag gtagcgtcac gtgacgttag ctaacgctag gtagcgtcag ctgagcttac 16440
gtaagcgcac agatgaatac tagctgttgt tcacagttct agtgtctcct cattacgtga 16500
attcaagcta cgatcactat ctcaactcct acataaacat cagaatgcta caaaactatg 16560
cacaaaaaca aaagctacat ctaatacgtg aatcaattac tctcatcaca agaaagaaga 16620
tttcaatcac cgtcgagaag gaggattcag ttaattgaat caaagttccg atcaaactcg 16680
aagactggtg agcacgagga cgacgaagaa gagtgtctcg aagatacaac aagcaagaaa 16740
tctactgagt gacctcctga agttattggc gcgattgaga gaatcaatcc gaattaattt 16800
cggggaaaaa gataaattag atactaagcg atgggcttgg gctgggctaa gaaacaggtg 16860
gcaattgggc tggaggaccc cgcgattcat agcttccgat agcccaaaaa aaaacggata 16920
acatatttat cgggtatttg aatttcagtg aaataagata ttttcttttt gttaggaaaa 16980
ttttagaaaa taatggaaat taaatagcga ttatgttaca agatacgatc agcatcgggc 17040
agtgcaaaat gctatagctt cccaagattt gatccttttg ggttatctcc taatgacaat 17100
tagtttagga ttttgaaact tatattaata ctattatccg acaacacttg tttcagcttc 17160
ttattttaac attttttgtt tttttctatt cttcttccca tcagcatttt ctttttaaaa 17220
aattgaatac tttaactttt taaaaatttc acaatgatca gatgatatta tggaagatct 17280
caagagttaa atgtatccat cttggggcat taaaaccggt gtacgggatg ataaatacag 17340
actttatatc atatgatagc tcagtaattc atatttatca cgttgctaaa aaaattataa 17400
ggtactagta gtcaacaaaa tcaattaaag agaaagaaag aaacgcatgt gaagagagtt 17460
tacaactgga aaagtaaaat aaaaattaac gcatgttgaa tgctgacatg tcagtatgtc 17520
catgaatcca cgtatcaagc gccattcatc gatcgtcttc ctctttctaa atgaaaacaa 17580
cttcacacat cacaacaaac aatacacaca agaccccctc tctctcgttg tctctctgcc 17640
agcgaccaaa tcgaagcttg agaagaacaa gaaggggtca aaccatggct tctacatctg 17700
ctgctcaaga cgctgctcct tacgagttcc cttctctcac tgagatcaag agggctcttc 17760

cttctgagtg tttcgaggct tctgttcctc tttctctcta ctacaccgct agatctcttg 17820
ctcttgctgg atctctcgct gttgctctct cttacgctag agctttgcct cttgttcagg 17880
ctaacgctct tcttgatgct actctctgca ctggatacgt tcttctccag ggaatcgttt 17940
tctggggatt cttcaccgtt ggtcacgatt gtggacacgg agctttctct agatctcacg 18000
tgctcaactt ctctgttgga accctcatgc actctatcat ccttacccct ttcgagtctt 18060
ggaagctctc tcacagacac caccacaaga acaccggaaa catcgataag gacgagatct 18120
tctaccctca aagagaggct gattctcacc ctgtttctag acaccttgtg atgtctcttg 18180
gatctgcttg gttcgcttac cttttcgctg gattccctcc tagaaccatg aaccacttca 18240
acccttggga ggctatgtat gttagaagag tggctgctgt gatcatctct ctcggagttc 18300
ttttcgcttt cgctggactc tactcttacc tcaccttcgt tcttggattc accactatgg 18360
ctatctacta cttcggacct ctcttcatct tcgctaccat gcttgttgtt accactttcc 18420
tccaccacaa cgatgaggag acaccttggt acgctgattc tgagtggact tacgtgaagg 18480
gaaacctctc ttctgtggac agatcttacg gtgctctcat cgacaacctt agccacaaca 18540
tcggaactca ccagatccac cacctcttcc ctatcatccc tcactacaag ctcaacgatg 18600
ctactgctgc tttcgctaag gctttccctg agcttgttag gaaaaacgct gctcctatca 18660
tcccaacttt cttcaggatg gctgctatgt acgctaagta cggagttgtt gacactgatg 18720
ctaagacctt cactctcaag gaggctaagg ctgctgctaa gactaagtca tcttgatgat 18780
taatgaataa ttgattgtac atactatatt ttttgtttac cttgtgttag tttaatgttc 18840
agtgtcctct ctttattgtg gcacgtctct ttgttgtatg ttgtgtctat acaaagttga 18900
aataatggaa agaaaaggaa gagtgtaatt tgttttgttt taagtgttta taaatatata 18960
tatataggtc atttagatag ttctaggttt ctataaaact ctctctctgg aagtagaatc 19020
tgtttttgag aggatccagt tgcctactaa tctcccccaa aacccttcaa gcttaacctt 19080
cctcttcaca acaacagagg aaacacatct cttgagctct gagttctctt ctttgagcat 19140
gtctatcgct aaactcatct gccttatagc ttccctcttc tcttcatctc tctctctcac 19200
catttcgctg taaaacttat tctcctccct cagcctctct atctcttcct tcagcatctc 19260
acaattccca ccataatcga ctgaggatga ttcaccgtca tcaacttcag actcagcgtt 19320
gtagtcgtca tgagtctcac aagccttgga ccaagaagac tcatcatcgc aagttgatga 19380
tttatcatga tgcttctctg agccgtgttt gctacgtagc gtcacgtgac gttacctaag 19440
cctaggtagc ctcagctgac gttacgtaac gctaggtagg ctcagctgac tgcagcaaat 19500
ttacacattg ccactaaacg tctaaaccct tgtaatttgt ttttgtttta ctatgtgtgt 19560
tatgtatttg atttgcgata aatttttata tttggtacta aatttataac accttttatg 19620
ctaacgtttg ccaacactta gcaatttgca agttgattaa ttgattctaa attatttttg 19680
tcttctaaat acatatacta atcaactgga aatgtaaata tttgctaata tttctactat 19740
aggagaatta aagtgagtga atatggtacc acaaggtttg gagatttaat tgttgcaatg 19800
ctgcatggat ggcatataca ccaaacattc aataattctt gaggataata atggtaccac 19860
acaagatttg aggtgcatga acgtcacgtg gacaaaaggt ttagtaattt ttcaagacaa 19920
caatgttacc acacacaagt tttgaggtgc atgcatggat gccctgtgga aagtttaaaa 19980
atattttgga aatgatttgc atggaagcca tgtgtaaaac catgacatcc acttggagga 20040
tgcaataatg aagaaaacta caaatttaca tgcaactagt tatgcatgta gtctatataa 20100
tgaggatttt gcaatacttt cattcataca cactcactaa gttttacacg attataattt 20160
cttcatagcc agtactgttt aagcttcact gtctctgaat cggcaaaggt aaacgtatca 20220
attattctac aaaccctttt atttttcttt tgaattaccg tcttcattgg ttatatgata 20280
acttgataag taaagcttca ataattgaat ttgatctgtg tttttttggc cttaatacta 20340
aatccttaca taagctttgt tgcttctcct cttgtgagtt gagtgttaag ttgtaataat 20400
ggttcacttt cagctttaga agaaacgcgc cttccatggc tacaaaggag gcttacgttt 20460
tcccaactct caccgagatc aagagatctc tcccaaagga ttgcttcgag gcttctgtgc 20520
ctttgtctct ctactacact gtgagatgct tggttattgc tgtggctttg accttcggat 20580
tgaactacgc tagagctttg ccagaggttg agtctttctg ggctttggat gctgctttgt 20640
gcactggata tatcctcctc cagggaattg tgttctgggg attcttcact gttggacacg 20700
atgctggaca cggagctttc tctagatacc acctcttgaa cttcgttgtg ggaaccttca 20760
tgcactctct catcttgacc ccattcgagt cttggaagtt gacccacaga caccaccaca 20820
agaacaccgg aaacatcgat agagatgagg tgttctaccc acagagaaag gctgatgatc 20880
acccattgtc caggaacttg atcttggctt tgggagctgc ttggcttgct tatttggtgg 20940
agggattccc accaagaaag gtgaaccact tcaacccatt cgagccactt tttgtgagac 21000
aagtgtccgc tgtggttatc tctttgctcg ctcacttctt cgttgctgga ctctctatct 21060
acttgtctct ccagttggga cttaagacca tggctatcta ctactacgga ccagttttcg 21120
tgttcggatc tatgttggtg attaccacct tcttgcacca caacgatgag gagactccat 21180
ggtatgctga ttctgagtgg acttacgtga agggaaactt gtcctctgtg gatagatctt 21240
acggtgctct catcgataac ctctcccaca acatcggaac tcaccagatc caccacctct 21300
tcccaattat cccacactac aagctcaaga aggctactgc tgctttccac caagctttcc 21360
cagagcttgt gagaaagtcc gatgagccaa tcatcaaggc tttcttcaga gtgggaaggt 21420
tgtatgctaa ctacggagtg gttgatcaag aggctaagct cttcactttg aaggaggcta 21480
aggctgctac tgaagctgct gctaagacca agtctacctg attaatgaat cgacaagctc 21540
gagtttctcc ataataatgt gtgagtagtt cccagataag ggaattaggg ttcctatagg 21600
gtttcgctca tgtgttgagc atataagaaa cccttagtat gtatttgtat ttgtaaaata 21660
cttctatcaa taaaatttct aattcctaaa accaaaatcc agtactaaaa tccagatccc 21720
ccgaattaat tcggcgttaa ttcagctacg taggctcagc tgagcttacc taaggctacg 21780
taggctcacg tgacgttacg taaggctacg tagcgtcacg tgagcttacc taactctagc 21840

tagcctcacg tgaccttagc taacactagg tagcgtcagc acagatgaat actagctgtt 21900
gttcacagtt ctagtgtctc ctcattacgt gaattcaagc tacgatcact atctcaactc 21960
ctacataaac atcagaatgc tacaaaacta tgcacaaaaa caaaagctac atctaatacg 22020
tgaatcaatt actctcatca caagaaagaa gatttcaatc accgtcgaga aggaggattc 22080
agttaattga atcaaagttc cgatcaaact cgaagactgg tgagcacgag gacgacgaag 22140
aagagtgtct cgaagataca acaagcaaga aatctactga gtgacctcct gaagttattg 22200
gcgcgattga gagaatcaat ccgaattaat ttcggggaaa aagataaatt agatactaag 22260
cgatgggctt gggctgggct aagaaacagg tggcaattgg gctggaggac cccgcgattc 22320
atagcttccg atagcccaaa aaaaaacgga taacatattt atcgggtatt tgaatttcag 22380
tgaaataaga tattttcttt ttgttaggaa aattttagaa aataatggaa attaaatagc 22440
gattatgtta caagatacga tcagcatcgg gcagtgcaaa atgctatagc ttcccaagat 22500
ttgatccttt tgggttatct cctaatgaca attagtttag gattttgaaa cttatattaa 22560
tactattatc cgacaacact tgtttcagct tcttatttta acattttttg tttttttcta 22620
ttcttcttcc catcagcatt ttctttttaa aaaattgaat actttaactt tttaaaaatt 22680
tcacaatgat cagatgatat tatggaagat ctcaagagtt aaatgtatcc atcttggggc 22740
attaaaaccg gtgtacggga tgataaatac agactttata tcatatgata gctcagtaat 22800
tcatatttat cacgttgcta aaaaaattat aaggtactag tagtcaacaa aatcaattaa 22860
agagaaagaa agaaacgcat gtgaagagag tttacaactg gaaaagtaaa ataaaaatta 22920
acgcatgttg aatgctgaca tgtcagtatg tccatgaatc cacgtatcaa gcgccattca 22980
tcgatcgtct tcctctttct aaatgaaaac aacttcacac atcacaacaa acaatacaca 23040
caagaccccc tctctctcgt tgtctctctg ccagcgacca aatcgaagct tgagaagaac 23100
aagaaggggt caaaccatgg gaaaaggatc tgagggaaga tctgctgcta gagagatgac 23160
tgctgaggct aacggagata agagaaagac catcctcatt gagggagtgt tgtacgatgc 23220
taccaacttc aaacacccag gaggttccat tattaacttc ctcaccgagg gagaagctgg 23280
agttgatgct acccaagctt acagagagtt ccatcagaga tccggaaagg ctgataagta 23340
cctcaagtcc ctcccaaagt tggatgcttc taaggtggag tctaggttct ctgctaagga 23400
gcaggctaga agggacgcta tgaccaggga ttacgctgct ttcagagagg agttggttgc 23460
tgagggatac ttcgatccat ctatcccaca catgatctac agagtggtgg agattgtggc 23520
tttgttcgct ttgtctttct ggttgatgtc taaggcttct ccaacctctt tggttttggg 23580
agtggtgatg aacggaatcg ctcaaggaag atgcggatgg gttatgcacg agatgggaca 23640
cggatctttc actggagtta tctggctcga tgataggatg tgcgagttct tctacggagt 23700
tggatgtgga atgtctggac actactggaa gaaccagcac tctaagcacc acgctgctcc 23760
aaacagattg gagcacgatg tggatttgaa caccttgcca ctcgttgctt tcaacgagag 23820
agttgtgagg aaggttaagc caggatcttt gttggctttg tggctcagag ttcaggctta 23880
tttgttcgct ccagtgtctt gcttgttgat cggattggga tggaccttgt acttgcaccc 23940
aagatatatg ctcaggacca agagacacat ggagtttgtg tggatcttcg ctagatatat 24000
cggatggttc tccttgatgg gagctttggg atattctcct ggaacttctg tgggaatgta 24060
cctctgctct ttcggacttg gatgcatcta catcttcctc caattcgctg tgtctcacac 24120
ccacttgcca gttaccaacc cagaggatca attgcactgg cttgagtacg ctgctgatca 24180
caccgtgaac atctctacca agtcttggtt ggttacctgg tggatgtcta acctcaactt 24240
ccaaatcgag caccacttgt tcccaaccgc tccacaattc aggttcaagg agatctctcc 24300
aagagttgag gctctcttca agagacacaa cctcccttac tacgatttgc catacacctc 24360
tgctgtttct actaccttcg ctaacctcta ctctgttgga cactctgttg gagctgatac 24420
caagaagcag gattgatgat taatgaataa ttgattgtac atactatatt ttttgtttac 24480
cttgtgttag tttaatgttc agtgtcctct ctttattgtg gcacgtctct ttgttgtatg 24540
ttgtgtctat acaaagttga aataatggaa agaaaaggaa gagtgtaatt tgttttgttt 24600
taagtgttta taaatatata tatataggtc atttagatag ttctaggttt ctataaaact 24660
ctctctctgg aagtagaatc tgtttttgag aggatccagt tgcctactaa tctcccccaa 24720
aacccttcaa gcttaacctt cctcttcaca acaacagagg aaacacatct cttgagctct 24780
gagttctctt ctttgagcat gtctatcgct aaactcatct gccttatagc ttccctcttc 24840
tcttcatctc tctctctcac catttcgctg taaaacttat tctcctccct cagcctctct 24900
atctcttcct tcagcatctc acaattccca ccataatcga ctgaggatga ttcaccgtca 24960
tcaacttcag actcagcgtt gtagtcgtca tgagtctcac aagccttgga ccaagaagac 25020
tcatcatcgc aagttgatga tttatcatga tgcttctctg agccgtgttt gctacctaga 25080
gtcagctgag cttagctaac gctagctagt gtcagctgac gttacgtaag gctaactagc 25140
gtcacgtgac cttacgtaac gctacgtagg ctcagctgag cttagctaac cctagctagt 25200
gtcacgtgag cttacgctac tatagaaaat gtgttatatc gacatgacca gacaaagggg 25260
caacagttaa caaaacaatt aattctttca tttgagatta aggaaggtaa ggtactaaaa 25320
agattaaaaa aaatgagctt atctctttgt ttctgtaata ataatataag tgtgataaac 25380
ttttaatata ataattgtaa ttaggttttc tacagatgag caccactcag agacaagata 25440
agaagaaaac aattttgtta aacatgatta tagaaacttt tagttaagtc ttgaagtatc 25500
aatataacaa aaaaaagtac acacgactat gacaataaac ccactaccgt caggttatca 25560
tttcgatgaa atgttttgat atcattaaat ataacagtca caaaaaatca tctaattata 25620
acaatataac ttatacatat atttaactaa aaacttagag tttttgtaat gattctaatt 25680
gatgattaga gtttatagaa atacaattaa ataaaaaata taattttaaa aaaacatagt 25740
aaagtcaatg agatcctctc tgacctcagt gatcatttag tcatgtatgt acaacaatca 25800
ttgttcatca catgactgta aaataaataa ggataaactt gggaatatat ataatatatt 25860
gtattaaata aaaaagggaa atacaaatat caattttaga ttcccgagtt gacacaactc 25920

accatgcacg ctgccacctc agctcccagc tctcgtcaca tgtctcatgt cagttaggtc 25980
tttggttttt agtctttgac acaactcgcc atgcatgttg ccacgtgagc tcgttcctct 26040
tcccatgatc tcaccactgg gcatgcatgc tgccacctca gctggcacct cttctctata 26100
tgtccctaga ggccatgcac agtgccacct cagcactcct ctcagaaccc atacgtacct 26160
gccaatcggc ttctctccat aaatatctat ttaaattata actaattatt tcatatactt 26220
aattgatgac gtggatgcat tgccatcgtt gtttaataat tgttaattac gacatgataa 26280
ataaaatgaa agtaaaaagt acgaaagatt ttccatttgt tgttgtataa atagagaagt 26340
gagtgatgca taatgcatga atgcatgacc gcgccaccat gactgttgga tacgacgagg 26400
agatcccatt cgagcaagtt agggctcata acaagccaga cgacgcttgg tgtgctattc 26460
acggacacgt gtacgacgtt accaagttcg cttcagttca cccaggagga gatattatct 26520
tgctcgctgc tggaaaggaa gctactgtcc tctacgagac ctaccatgtt agaggagtgt 26580
ctgacgctgt gctcagaaag tacagaatag gaaagttgcc agacggacaa ggaggagcta 26640
acgagaagga gaagagaacc ttgtctggat tgtcctctgc ttcttactac acctggaact 26700
ccgatttcta cagagtgatg agggagagag ttgtggctag attgaaggag agaggaaagg 26760
ctagaagagg aggatacgaa ctctggatca aggctttctt gctccttgtt ggattctggt 26820
cctctcttta ctggatgtgc accctcgatc catctttcgg agctatcttg gctgctatgt 26880
ctttgggagt gttcgctgct tttgttggaa cctgcatcca acacgatgga aaccacggag 26940
ctttcgctca atctagatgg gttaacaagg tggcaggatg gactttggat atgatcggag 27000
cttctggaat gacttgggag ttccaacacg tgttgggaca ccacccatac actaacttga 27060
tcgaggagga gaacggattg caaaaggtgt ccggaaagaa gatggatacc aagttggctg 27120
atcaagagtc tgatccagat gtgttctcca cctacccaat gatgagattg cacccttggc 27180
accagaagag gtggtatcac aggttccagc acatctacgg acctttcatc ttcggattca 27240
tgaccatcaa caaggtggtg actcaagatg ttggagtggt gttgagaaag agactcttcc 27300
aaatcgatgc tgagtgcaga tatgcttccc caatgtacgt tgctaggttc tggattatga 27360
aggctttgac cgtgttgtat atggttgctt tgccttgtta tatgcaagga ccttggcacg 27420
gattgaaact cttcgctatc gctcacttca cttgcggaga ggttttggct accatgttca 27480
tcgtgaacca cattatcgag ggagtgtctt acgcttctaa ggatgctgtt aagggaacta 27540
tggctccacc aaagactatg cacggagtga ccccaatgaa caacactaga aaggaggttg 27600
aggctgaggc ttctaagtct ggagctgtgg ttaagtctgt gccattggat gattgggctg 27660
ctgttcagtg ccaaacctct gtgaactggt ctgttggatc ttggttttgg aaccacttct 27720
ctggaggact caaccaccaa atcgagcacc acctcttccc aggattgtct cacgagacct 27780
actaccacat ccaagacgtg gttcaatcta cctgtgctga gtacggagtt ccataccaac 27840
acgagccatc tttgtggact gcttactgga agatgctcga acaccttaga caattgggaa 27900
acgaggagac tcacgagtca tggcagagag ctgcttgatt aatgaactaa gactcccaaa 27960
accaccttcc ctgtgacagt taaaccctgc ttataccttt cctcctaata atgttcatct 28020
gtcacacaaa ctaaaataaa taaaatggga gcaataaata aaatgggagc tcatatattt 28080
acaccattta cactgtctat tattcaccat gccaattatt acttcataat tttaaaatta 28140
tgtcattttt aaaaattgct taatgatgga aaggattatt ataagttaaa agtataacat 28200
agataaacta accacaaaac aaatcaatat aaactaactt actctcccat ctaattttta 28260
tttaaatttc tttacacttc tcttccattt ctatttctac aacattattt aacattttta 28320
ttgtattttt cttactttct aactctattc atttcaaaaa tcaatatatg tttatcacca 28380
cctctctaaa aaaaacttta caatcattgg tccagaaaag ttaaatcacg agatggtcat 28440
tttagcatta aaacaacgat tcttgtatca ctatttttca gcatgtagtc cattctcttc 28500
aaacaaagac agcggctata taatcgttgt gttatattca gtctaaaaca actagctagc 28560
ctcagctgac gttacgtaac gctaggtagc gtcacgtgac gttagctaac gctaggtagc 28620
gtcagctgag cttacgtaag cgccacgggc aggacatagg gactactaca agcatagtat 28680
gcttcagaca aagagctagg aaagaactct tgatggaggt taagagaaaa aagtgctaga 28740
ggggcatagt aatcaaactt gtcaaaaccg tcatcatgat gagggatgac ataatataaa 28800
aagttgacta aggtcttggt agtactcttt gattagtatt atatattggt gagaacatga 28860
gtcaagagga gacaagaaac cgaggaacca tagtttagca acaagatgga agttgcaaag 28920
ttgagctagc cgctcgatta gttacatctc ctaagcagta ctacaaggaa tggtctctat 28980
actttcatgt ttagcacatg gtagtgcgga ttgacaagtt agaaacagtg cttaggagac 29040
aaagagtcag taaaggtatt gaaagagtga agttgatgct cgacaggtca ggagaagtcc 29100
ctccgccaga tggtgactac caaggggttg gtatcagctg agacccaaat aagattcttc 29160
ggttgaacca gtggttcgac cgagactctt agggtgggat ttcactgtaa gatttgtgca 29220
ttttgttgaa tataaattga caattttttt tatttaatta tagattattt agaatgaatt 29280
acatatttag tttctaacaa ggatagcaat ggatgggtat gggtacaggt taaacatatc 29340
tattacccac ccatctagtc gtcgggtttt acacgtaccc acccgtttac ataaaccaga 29400
ccggaatttt aaaccgtacc cgtccgttag cgggtttcag atttacccgt ttaatcgggt 29460
aaaacctgat tactaaatat atattttta tttgataaac aaaacaaaaa tgttaatatt 29520
ttcatattgg atgcaatttt aagaaacaca tattcataaa tttccatatt tgtaggaaaa 29580
taaaaagaaa aatatattca agaacacaaa tttcaccgac atgactttta ttacagagtt 29640
ggaattagat ctaacaattg aaaaattaaa attaagatag aatatgttga ggaacatgac 29700
atagtataat gctgggttac ccgtcgggta ggtatcgagg cggatactac taaatccatc 29760
ccactcgcta tccgataatc actggtttcg ggtataccca ttcccgtcaa caggcctttt 29820
taaccggata atttcaactt atagtgaatg aattttgaat aaatagttag aataccaaaa 29880
tcctggattg catttgcaat caaattttgt gaaccgttaa attttgcatg tacttgggat 29940
agatataata gaaccgaatt ttcattagtt taatttataa cttactttgt tcaaagaaaa 30000

aaaatatcta tccaatttac ttataataaa aaataatcta tccaagttac ttattataat 30060
caacttgtaa aaaggtaaga atacaaatgt ggtagcgtac gtgtgattat atgtgacgaa 30120
atgttatatc taacaaaagt ccaaattccc atggtaaaaa aaatcaaaat gcatggcagg 30180
ctgtttgtaa ccttggaata agatgttggc caattctgga gccgccacgt acgcaagact 30240
cagggccacg ttctcttcat gcaaggatag tagaacacca ctccacccac ctcctatatt 30300
agacctttgc ccaaccctcc ccaactttcc catcccatcc acaaagaaac cgacattttt 30360
atcataaatc agggtttcgt ttttgtttca tcgataaact caaaggtgat gattttaggg 30420
tcttgtgagt gtgctttttt gtttgattct actgtagggt ttatgttctt tagctcatag 30480
gttttgtgta tttcttagaa atgtggcttc tttaatctct gggtttgtga ctttttgtgt 30540
ggtttctgtg tttttcatat caaaaaccta ttttttccga gttttttttt acaaattctt 30600
actctcaagc ttgaatactt cacatgcagt gttcttttgt agattttaga gttaatgtgt 30660
taaaaagttt ggatttttct tgcttataga gcttcttcac tttgattttg tgggtttttt 30720
tgttttaaag gtgagatttt tgatgaggtt tttgcttcaa agatgtcacc tttctgggtt 30780
tgtcttttga ataaagctat gaactgtcac atggctgacg caattttgtt actatgtcat 30840
gaaagctgac gtttttccgt gttatacatg tttgcttaca cttgcatgcg tcaaaaaaat 30900
tggggctttt tagttttagt caaagatttt acttctcttt tgggatttat gaaggaaagt 30960
tgcaaacttt ctcaaatttt accattttttg ctttgatgtt tgtttagatt gcgacagaac 31020
aaactcatat atgttgaaat ttttgcttgg ttttgtatag gattgtgtct tttgcttata 31080
aatgttgaaa tctgaacttt tttttgttt ggtttctttg agcaggagat aaggcgcacc 31140
accatggctt ctacatctgc tgctcaagac gctgctcctt acgagttccc ttctctcact 31200
gagatcaaga gggctcttcc ttctgagtgt ttcgaggctt ctgttcctct ttctctctac 31260
tacaccgcta gatctcttgc tcttgctgga tctctcgctg ttgctctctc ttacgctaga 31320
gctttgcctc ttgttcaggc taacgctctt cttgatgcta ctctctgcac tggatacgtt 31380
cttctccagg gaatcgtttt ctggggattc ttcaccgttg gtcacgattg tggacacgga 31440
gctttctcta gatctcacgt gctcaacttc tctgttggaa ccctcatgca ctctatcatc 31500
cttacccctt tcgagtcttg gaagctctct cacagacacc accacaagaa caccggaaac 31560
atcgataagg acgagatctt ctaccctcaa agagaggctg attctcaccc tgtttctaga 31620
caccttgtga tgtctcttgg atctgcttgg ttcgcttacc ttttcgctgg attccctcct 31680
agaaccatga accacttcaa cccttgggag gctatgtatg ttagaagagt ggctgctgtg 31740
atcatctctc tcggagttct tttcgctttc gctggactct actcttacct caccttcgtt 31800
cttggattca ccactatggc tatctactac ttcggacctc tcttcatctt cgctaccatg 31860
cttgttgtta ccactttcct ccaccacaac gatgaggaga caccttggta cgctgattct 31920
gagtggactt acgtgaaggg aaacctctct tctgtggaca gatcttacgg tgctctcatc 31980
gacaacctta gccacaacat cggaactcac cagatccacc acctcttccc tatcatccct 32040
cactacaagc tcaacgatgc tactgctgct ttcgctaagg ctttccctga gcttgttagg 32100
aaaaacgctg ctcctatcat cccaactttc ttcaggatgg ctgctatgta cgctaagtac 32160
ggagttgttg acactgatgc taagaccttc actctcaagg aggctaaggc tgctgctaag 32220
actaagtcat cttgatgatt aatgaaggcc gcagatatca gatctggtcg acctagagga 32280
tccccggccg caaagataat aacaaaagcc tactatataa cgtacatgca agtattgtat 32340
gatattaatg tttttacgta cgtgtaaaca aaaataatta cgtttgtaac gtatggtgat 32400
gatgtggtgc actaggtgta ggccttgtat taataaaaag aagtttgttc tatatagagt 32460
ggtttagtac gacgatttat ttactagtcg gattggaata gagaaccgaa ttcttcaatc 32520
cttgcttttg atcaagaatt gaaaccgaat caaatgtaaa agttgatata tttgaaaaac 32580
gtattgagct tatgaaaatg ctaatactct catctgtatg gaaaagtgac tttaaaaccg 32640
aacttaaaag tgacaaaagg ggaatatcgc atcaaaccga atgaaaccga tctacgtagg 32700
ctcagctgag cttacctaag gctacgtagg ctcacgtgac gttacgtaag gctacgtagc 32760
gtcacgtgag cttacctaac tctagctagc ctcacgtgac cttagctaac actaggtagc 32820
gtcagcttag cagatatttg gtgtctaaat gtttattttg tgatatgttc atgtttgaaa 32880
tggtggtttc gaaaccaggg acaacgttgg gatctgatag ggtgtcaaag agtattatgg 32940
attgggacaa tttcggtcat gagttgcaaa ttcaagtata tcgttcgatt atgaaaattt 33000
tcgaagaata tcccatttga gagagtcttt acctcattaa tgtttttaga ttatgaaatt 33060
ttatcatagt tcatcgtagt ctttttggtg taaaggctgt aaaaagaaat tgttcacttt 33120
tgttttcgtt tatgtgaagg ctgtaaaaga ttgtaaaaga ctattttggt gttttggata 33180
aaatgatagt ttttatagat tcttttgctt ttagaagaaa tacatttgaa atttttttcca 33240
tgttgagtat aaaataccga aatcgattga agatcataga aatattttaa ctgaaaacaa 33300
atttataact gattcaattc tctccatttt tatacctatt taaccgtaat cgattctaat 33360
agatgatcga ttttttatat aatcctaatt aaccaacggc atgtattgga taattaaccg 33420
atcaactctc acccctaata gaatcagtat tttccttcga cgttaattga tcctacacta 33480
tgtaggtcat atccatcgtt ttaatttttg gccaccattc aattctgtct tgcctttagg 33540
gatgtgaata tgaacggcca aggtaagaga ataaaaataa tccaaattaa agcaagagag 33600
gccaagtaag ataatccaaa tgtacacttg tcattgccaa aattagtaaa atactcggca 33660
tattgtattc ccacacatta ttaaaatacc gtatatgtat tggctgcatt tgcatgaata 33720
atactacgtg taagcccaaa agaacccacg tgtagcccat gcaaagttaa cactcacgac 33780
cccattcctc agtctccact atataaaccc accatcccca atctcaccaa acccaccaca 33840
caactcacaa ctcactctca caccttaaag aaccaatcac caccaaaaaa agttctttgc 33900
tttcgaagtt gccgcaacct aaacaggttt ttccttcttc tttcttctta ttaactacga 33960
ccttgtcctt tgcctatgta aaattactag gttttcatca gttacactga ttaagttcgt 34020
tatagtggaa gataaaatgc cctcaaagca ttttgcagga tatctttgat ttttcaaaga 34080

tatggaactg tagagtttga tagtgttctt gaatgtggtt gcatgaagtt tttttggtct 34140
gcatgttatt ttttcctcga aatatgtttt gagtccaaca agtgattcac ttgggattca 34200
gaaagttgtt ttctcaatat gtaacagttt ttttctatgg agaaaaaatca tagggaccgt 34260
tggttttggc ttctttaatt ttgagctcag attaaaccca ttttacccgg tgttcttggc 34320
agaattgaaa acagtacgta gtaccgcgcc taccatgcca cctagtgctg ctagtgaagg 34380
tggtgttgct gaacttagag ctgctgaagt tgctagctac actagaaagg ctgttgacga 34440
aagacctgac ctcactatag ttggtgacgc tgtttacgac gctaaggctt ttagggacga 34500
gcaccctggt ggtgctcact tcgttagcct tttcggaggt agggacgcta ctgaggcttt 34560
tatggaatat caccgtagag cttggcctaa ggctaggatg tctaagttct tcgttggttc 34620
acttgacgct agcgagaagc ctactcaagc tgattcagct taccttagac tttgcgctga 34680
ggttaacgct cttttgccta agggtagcgg aggattcgct cctcctagct actggcttaa 34740
ggctgctgct cttgttgttg ctgctgttag tatagagggt tatatgctcc ttaggggtaa 34800
gaccctttttg cttagcgttt tccttggact cgtgttcgct tggataggac ttaatattca 34860
gcacgacgct aatcacggtg ctcttagtag acactcagtg attaactact gcctcggtta 34920
cgctcaggat tggataggtg gtaatatggt gctttggctt caagagcacg ttgtgatgca 34980
ccacctccac actaacgacg ttgacgctga tcctgatcaa aaggctcacg gtgttcttag 35040
acttaagcct actgacggtt ggatgccttg gcacgcactt caacaactct atatccttcc 35100
tggtgaggct atgtacgctt ttaagcttct tttcttggac gcccttgagc ttcttgcttg 35160
gaggtgggag ggtgagaaga ttagccctct tgctagagct ttgttcgctc ctgctgttgc 35220
ttgtaagctt ggattctggg ctagattcgt tgctctccct ctctggcttc aacctactgt 35280
tcacactgct ttgtgtatct gtgctactgt gtgtactggt agcttctacc tcgccttctt 35340
cttctttatc tctcacaact tcgacggtgt tggtagcgtt ggacctaagg gatcacttcc 35400
tagatcagct actttcgttc aacgtcaggt tgagactagc tctaacgttg gtggttactg 35460
gcttggagtt cttaacggtg gacttaactt tcagatagag caccacttgt tccctaggct 35520
tcaccactct tactacgctc aaatagctcc tgtggttagg actcacatag agaagctcgg 35580
ttttaagtac cgtcacttcc ctaccgttgg atctaacctt agctcaatgc ttcagcatat 35640
gggtaagatg ggaactagac ctggtgctga gaagggtggt aaggctgagt agtgattaat 35700
gaataattga ttgctgcttt aatgagatat gcgagacgcc tatgatcgca tgatatttgc 35760
tttcaattct gttgtgcacg ttgtaaaaaa cctgagcatg tgtagctcag atccttaccg 35820
ccggtttcgg ttcattctaa tgaatatatc acccgttact atcgtatttt tatgaataat 35880
attctccgtt caatttactg attgtctacg tagcgtcacc tgacgttacg taaggctacc 35940
taggctcacg tgacgttacg taacgctacg tagcgtcagg tgaggttagc taacgctagc 36000
tagcctcacc tgacgttagg taaggctacg tagcgtcacc tgagattagc taagcctacc 36060
tagactcacg tgaccttagg taacgctacg tagcgtcaaa gctttacaac gctacacaaa 36120
acttataacc gtaatcacca ttcattaact taactactat cacatgcatt catgaattga 36180
aacgagaagg atgtaaatag ttgggaagtt atctccacgt tgaagagatc gttagcgaga 36240
gctgaaagac cgagggagga gacgccgtca acacggacag agtcgtcgac cctcacatga 36300
agtaggagga atctccgtga ggagccagag agacgtcttt ggtcttcggt ttcgatcctt 36360
gatctgacgg agaagacgag agaagtgcga ctggactccg tgaggaccaa cagagtcgtc 36420
ctcggtttcg atcgtcggta ttggtggaga aggcggagga atctccgtga cgagccagag 36480
agatgtcgtc ggtcttcggt ttcgatcctt gatctgacgg agaagacgag agaagtgcga 36540
cgagactccg tgaggaccaa cagagttgtc ctcggtttcg atcgtcggtt tcggcggaga 36600
aggcggagga atctccgtga ggagccagag agacgtcgtt ggtcttcggt ttcgatcctt 36660
gatctgttgg agaagacgag acaagtggga cgagactcaa cgacggagtc agagacgtcg 36720
tcggtcttcg gtttcggccg agaaggcgga gtcggtcttc ggtttcggcc gagaaggcgg 36780
aggagacgtc ttcgatttgg gtctctcctc ttgacgaaga aaacaaagaa cacgagaaat 36840
aatgagaaag agaacaaaag aaaaaaaaat aaaaataaaa ataaaatttg gtcctcttat 36900
gtggtgacac gtggtttgaa acccaccaaa taatcgatca caaaaaacct aagttaagga 36960
tcggtaataa cctttctaat taattttgat ttatattaaa tcactctttt tatttataaa 37020
ccccactaaa ttatgcgata ttgattgtct aagtacaaaa attctctcga attcaataca 37080
catgtttcat atatttagcc ctgttcattt aatattacta gcgcattttt aatttaaaat 37140
tttgtaaact tttttggtca aagaacattt ttttaattag agacagaaat ctagactctt 37200
tatttggaat aatagtaata aagatatatt aggcaatgag tttatgatgt tatgtttata 37260
tagtttattt cattttaaat tgaaaagcat tatttttatc gaaatgaatc tagtatacaa 37320
tcaatattta tgttttttca tcagatactt tcctattttt tggcaccttt catcggacta 37380
ctgatttatt tcaatgtgta tgcatgcatg agcatgagta tacacatgtc ttttaaaatg 37440
catgtaaagc gtaacggacc acaaaagagg atccatacaa atacatctca tcgcttcctc 37500
tactattctc cgacacacac actgagcatg gtgcttaaac actctggtga gttctagtac 37560
ttctgctatg atcgatctca ttaccatttc ttaaatttct ctccctaaat attccgagtt 37620
cttgattttt gataacttca ggtttttctct ttttgataaa tctggtcttt ccattttttt 37680
tttttttgtgg ttaatttagt ttcctatgtt cttcgattgt attatgcatg atctgtgttt 37740
ggattctgtt agattatgta ttggtgaata tgtatgtgtt tttgcatgtc tggttttggt 37800
cttaaaaatg ttcaaatctg atgatttgat tgaagctttt ttagtgttgg tttgattctt 37860
ctcaaaacta ctgttaattt actatcatgt tttccaactt tgattcatga tgacactttt 37920
gttctgcttt gttataaaat tttggttggt ttgattttgt aattatagtg taattttgtt 37980
aggaatgaac atgttttaat actctgtttt cgatttgtca cacattcgaa ttattaatcg 38040
ataatttaac tgaaaattca tggttctaga tcttgttgtc atcagattat ttgtttcgat 38100
aattcatcaa atatgtagtc cttttgctga tttgcgactg tttcattttt tctcaaaatt 38160

gtttttgtt aagtttatct aacagttatc gttgtcaaaa gtctctttca ttttgcaaaa 38220
tcttctttt ttttttgttt gtaactttgt tttttaagct acacatttag tctgtaaaat 38280
agcatcgagg aacagttgtc ttagtagact tgcatgttct tgtaacttct atttgtttca 38340
gtttgttgat gactgctttg attttgtagg tcaaaccgcg ccatgtctgc tagcggagct 38400
ttgttgcctg ctatagcttt cgctgcttac gcttacgcta cctacgctta tgctttcgag 38460
tggagccacg ctaacggaat cgataacgtg gatgctagag agtggattgg agctttgtct 38520
ttgagactcc ctgcaattgc aaccacaatg tacctcttgt tctgccttgt gggacctaga 38580
ttgatggcta agagggaggc ttttgatcct aagggattta tgctcgctta caacgcttac 38640
caaaccgctt tcaacgttgt ggtgctcgga atgttcgcta gagagatctc tggattggga 38700
caacctgttt ggggatctac tatgccttgg agcgatagga agtccttcaa gattttgttg 38760
ggagtgtggc tccactacaa caataagtac ctcgagttgt tggatactgt gttcatggtg 38820
gctaggaaaa agaccaagca gctctctttc ttgcacgtgt accaccacgc tttgttgatt 38880
tgggcttggt ggcttgtttg tcacctcatg gctaccaacg attgcatcga tgcttatttc 38940
ggagctgctt gcaactcttt catccacatc gtgatgtact cctactacct catgtctgct 39000
ttgggaatta ggtgcccttg gaagagatat atcacccagg ctcagatgtt gcaattcgtg 39060
atcgtgttcg ctcacgctgt tttcgtgctc agacaaaagc actgccctgt tactttgcct 39120
tgggcacaaa tgttcgtgat gacaaatatg ttggtgctct tcggaaactt ctacctcaag 39180
gcttactcta acaagtctag gggagatgga gcttcttctg ttaagcctgc tgagactact 39240
agagcacctt ctgtgagaag aaccaggtca aggaagatcg attgatagtt aatgaactaa 39300
gtttgatgta tctgagtgcc aacgtttact ttgtctttcc tttcttttat tggttatgat 39360
tagatgttta ctatgttctc tctttttcgt tataaataaa gaagttcaat tcttctatag 39420
tttcaaacgc gattttaagc gtttctattt aggtttacat gatttctttt acaaaatcat 39480
ctttaaaata cagtatattt ttagttttca taaaatattt aaagaaatga aagtttataa 39540
acattcactc ctattctcta attaaggatt tgtaaaacaa aaattttgta agcatatcga 39600
tttatgcgtt ttgtcttaat tagctcacta aataataaat aatagcttat gttgtgggac 39660
tgtttaatta cctaacttag aactaaaatc aactctttgt gctagctagc ctcagctgac 39720
gttacgtaac gctaggtagc gtcacgtgac gttagctaac gctaggtagc gtcagctgag 39780
cttacgtaag cgcttaatta aagtactgat atcggtacca aatcgaatcc aaaaattacg 39840
gatatgaata taggcatatc cgtatccgaa ttatccgttt gacagctagc aacgattgta 39900
caattgcttc tttaaaaaag gaagaaagaa agaaagaaaa gaatcaacat cagcgttaac 39960
aaacggcccc gttacggccc aaacggtcat atagagtaac ggcgttaagc gttgaaagac 40020
tcctatcgaa atacgtaacc gcaaacgtgt catagtcaga tcccctcttc cttcaccgcc 40080
tcaaacacaa aaataatctt ctacagccta tatatacaac ccccccttct atctctcctt 40140
tctcacaatt catcatcttt ctttctctac cccaatttt aagaaatcct ctcttctcct 40200
cttcattttc aaggtaaatc tctctctctc tctctctctc tgttattcct tgttttaatt 40260
aggtatgtat tattgctagt ttgttaatct gcttatctta tgtatgcctt atgtgaatat 40320
ctttatcttg ttcatctcat ccgtttagaa gctataaatt tgttgatttg actgtgtatc 40380
tacacgtggt tatgtttata tctaatcaga tatgaatttc ttcatattgt tgcgtttgtg 40440
tgtaccaatc cgaaatcgtt gattttttc atttaatcgt gtagctaatt gtacgtatac 40500
atatggatct acgtatcaat tgttcatctg tttgtgtttg tatgtataca gatctgaaaa 40560
catcacttct ctcatctgat tgtgttgtta catacataga tatagatctg ttatatcatt 40620
tttttttatta attgtgtata tatatatgtg catagatctg gattacatga ttgtgattat 40680
ttacatgatt ttgttattta cgtatgtata tatgtagatc tggacttttt ggagttgttg 40740
acttgattgt atttgtgtgt gtatatgtgt gttctgatct tgatatgtta tgtatgtgca 40800
gctgaaccat ggcggcggca acaacaacaa caacaacatc ttcttcgatc tccttctcca 40860
ccaaaccatc tccttcctcc tccaaatcac cattaccaat ctccagattc tccctcccat 40920
tctccctaaa ccccaacaaa tcatcctcct cctcccgccg ccgcggtatc aaatccagct 40980
ctccctcctc catctccgcc gtgctcaaca caaccaccaa tgtcacaacc actccctctc 41040
caaccaaacc taccaaaccc gaaacattca tctcccgatt cgctccagat caaccccgca 41100
aaggcgctga tatcctcgtc gaggctttag aacgtcaagg cgtagaaacc gtattcgctt 41160
accctggagg tacatcaatg gagattcacc aagccttaac ccgctcttcc tcaatccgta 41220
acgtccttcc tcgtcacgaa caaggaggtg tattcgcagc agaaggatac gctcgatcct 41280
caggtaaacc aggtatctgt atagccactt caggtcccgg agctacaaat ctcgttagcg 41340
gattagccga tgcgttgtta gatagtgttc ctcttgtagc aatcacagga caagtccctc 41400
gtcgtatgat tggtacagat gcgtttcaag agactccgat tgttgaggta acgcgttcga 41460
ttacgaagca taactatctt gtgatggatg ttgaagatat cccaaggatt attgaagagg 41520
ctttcttttt agctacttct ggtagacctg gacctgtttt ggttgatgtt cctaaagata 41580
ttcaacaaca gcttgcgatt cctaattggg aacaggctat gagattacct ggttatatgt 41640
ctaggatgcc taaacctccg gaagattctc atttggagca gattgttagg ttgatttctg 41700
agtctaagaa gcctgtgttg tatgttggtg gtggttgtct taattctagc gatgaattgg 41760
gtaggtttgt tgagcttacg ggcatccctg ttgcgagtac gttgatgggg ctgggatctt 41820
atccttgtga tgatgagttg tcgttacata tgcttggaat gcatgggact gtgtatgcaa 41880
attacgctgt ggagcatagt gatttgttgt tggcgtttgg ggtaaggttt gatgatcgtg 41940
tcacgggtaa acttgaggct tttgctagta gggctaagat tgttcatatt gatattgact 42000
cggctgagat tgggaagaat aagactcctc atgtgtctgt gtgtggtgat gttaagctgg 42060
ctttgcaagg gatgaataag gttcttgaga accgagcgga ggagcttaaa cttgattttg 42120
gagtttggag gaatgagttg aacgtacaga aacagaagtt tccgttgagc tttaagacgt 42180
ttggggaagc tattcctcca cagtatgcga ttaaggtcct tgatgagttg actgatggaa 42240

aagccataat aagtactggt gtcgggcaac atcaaatgtg ggcggcgcag ttctacaatt 42300
acaagaaacc aaggcagtgg ctatcatcag gaggccttgg agctatggga tttggacttc 42360
ctgctgcgat tggagcgtct gttgctaacc ctgatgcgat agttgtggat attgacggag 42420
atggaagttt tataatgaat gtgcaagagc tagccactat tcgtgtagag aatcttccag 42480
tgaaggtact tttattaaac aaccagcatc ttggcatggt tatgcaatgg gaagatcggt 42540
tctacaaagc taaccgagct cacacatttc tcggggaccc ggctcaggag gacgagatat 42600
tcccgaacat gttgctgttt gcagcagctt gcgggattcc agcggcgagg gtgacaaaga 42660
aagcagatct ccgagaagct attcagacaa tgctggatac accaggacct tacctgttgg 42720
atgtgatttg tccgcaccaa gaacatgtgt tgccgatgat cccgaatggt ggcactttca 42780
acgatgtcat aacggaagga gatggccgga ttaaatactg agagatgaaa ccggtgatta 42840
tcagaacctt ttatggtctt tgtatgcata tggtaaaaaa acttagtttg caatttcctg 42900
tttgttttgg taatttgagt ttcttttagt tgttgatctg cctgcttttt ggtttacgtc 42960
agactactac tgctgttgtt gtttggtttc ctttctttca ttttataaat aaataatccg 43020
gttcggttta ctccttgtga ctggctcagt ttggttattg cgaaatgcga atggtaaatt 43080
gagtaattga aattcgttat tagggttcta agctgtttta acagtcactg ggttaatatc 43140
tctcgaatct tgcatggaaa atgctcttac cattggtttt taattgaaat gtgctcatat 43200
gggccgtggt ttccaaatta aataaaacta cgatgtcatc gagaagtaaa atcaactgtg 43260
tccacattat cagttttgtg tatacgatga aatagggtaa ttcaaaatct agcttgatat 43320
gccttttggt tcattttaac cttctgtaaa catttttca gattttgaac aagtaaatcc 43380
aaaaaaaaaa aaaaaaatct caactcaaca ctaaattatt ttaatgtata aaagatgctt 43440
aaaacatttg gcttaaaaga aagaagctaa aaacatagag aactcttgta aattgaagta 43500
tgaaaatata ctgaattggg tattatatga atttttctga tttaggattc acatgatcca 43560
aaaaggaaat ccagaagcac taatcagaca ttggaagtag gattaatcag tgatcagtaa 43620
ctattaaatt caattaaccg cggacatcta catttttgaa ttgaaaaaaa attggtaatt 43680
actctttctt tttctccata ttgaccatca tactcattgt 43720

<210> 300
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 1 RB junction region

<400> 300
tataaataag cagtcagcat 20

<210> 301
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 1 LB junction region

<400> 301
tactcattgt aagacacaca 20

<210> 302
<211> 1600
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 1 flanking sequence up to and including the right border of the T-DNA

<400> 302
aaaagaaata taaaagaata tgaccaaaaa agtaaacgtg agtgagagaa taagaaaatg 60
actacaaaat ataatagcct caattatctt caaaactaag ttgacattta attatgcttt 120
tgcaagatat ttacttttgt tgttcgatca tatttaatga ttattttggt tttgaaacaa 180
atattaacat tatatatatt gtgtctatat tgaactgttg taaattataa acatcaaaat 240
tttaatgtta tcttaattat aatttctaat actagtatat tcaaaaatca aaataaacat 300
attttataaa atagtgccag tacgtagtat gggagataat actagtggct ttataaaggg 360
aaacattgtc tctaaaatct cagataaaat gttaaaacac acttattcac aattatgaag 420
atttgaaata tctgaaattt caaattgatg cacttggtag aaagcaaagg ttcaacgcta 480
agtctacaag gtgtaataat gaagtgaaaa tgctagttta gattaccctt gatatgtgac 540
tgaacatagg gtggagcgtc agtgagtcca tggagtacag aagctaaaca agagacatgg 600

ttaagcacca gaatcaactc gttctccata gagtccagct tttgagatat atgtgaatag 660
ccttgttgca atatacttgt gagtggcagg cgtgatctta ttaacgaaag tccaaattct 720
gaacaaagtt tatatcaagc tacgatggaa atatggaatc cgtatcaaaa tcaactgtac 780
tgtatcatac ggtgcagatt tttagctcga ctctaccacc ttgcgtttac ttttgtgatg 840
aacattgcga ttatatatga ggacctaaat agagggaaaa tgtatgaaga caggatccta 900
agaatgaaaa accagcatcc ccaagatgtg gcaccaagtg ctatcgacca caaactacgc 960
tggacatact ctgatatagt tcgttaagaa atcaaaatgt caacacatat aaataagcag 1020
tcagcatcat cacaccaaaa gttaggcccg aatagtttga aattagaaag ctcgcaattg 1080
aggtctacag gccaaattcg ctcttagccg tacaatatta ctcaccggtg cgatgccccc 1140
catcgtaggt gaaggtggaa attaatggcg cgcctgatca ctgattagta actattacgt 1200
aagcctacgt agcgtcacgt gacgttagct aacgctacgt agcctcagct gacgttacgt 1260
aagcctacgt agcgtcacgt gagcttagct aacgctacct aggctcagct gacgttacgt 1320
aacgctagct agcgtcactc ctgcagcaaa tttacacatt gccactaaac gtctaaaccc 1380
ttgtaatttg tttttgtttt actatgtgtg ttatgtattt gatttgcgat aaatttttat 1440
atttggtact aaatttataa cacctttat gctaacgttt gccaacactt agcaatttgc 1500
aagttgatta attgattcta aattattttt gtcttctaaa tacatatact aatcaactgg 1560
aaatgtaaat atttgctaat atttctacta taggagaatt 1600

<210> 303
<211> 1677
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 1 flanking sequence up to and including the left
border of the T-DNA

<400> 303
taattgaaat tcgttattag ggttctaagc tgttttaaca gtcactgggt taatatctct 60
cgaatcttgc atggaaaatg ctcttaccat tggtttttaa ttgaaatgtg ctcatatggg 120
ccgtggtttc caaattaaat aaaactacga tgtcatcgag aagtaaaatc aactgtgtcc 180
acattatcag ttttgtgtat acgatgaaat agggtaattc aaaatctagc ttgatatgcc 240
ttttggttca ttttaacctt ctgtaaacat tttttcagat tttgaacaag taaatccaaa 300
aaaaaaaaaa aaaatctcaa ctcaacacta aattatttta atgtataaaa gatgcttaaa 360
acatttggct taaaagaaag aagctaaaaa catagagaac tcttgtaaat tgaagtatga 420
aaatatactg aattgggtat tatatgaatt tttctgattt aggattcaca tgatccaaaa 480
aggaaatcca gaagcactaa tcagacattg gaagtaggat taatcagtga tcagtaacta 540
ttaaattcaa ttaaccgcgg acatctacat ttttgaattg aaaaaaaatt ggtaattact 600
ctttcttttt ctccatattg accatcatac tcattgtaag acacacagat gaagaagtca 660
aatagctcga cattcctttg gtctggtcca gtgatgtcga ctcacaaagc gaagattgca 720
tgaatagact atcatgtgtt tgctatgtat gagtactatg gaatcgaggg atcatttatt 780
tttcatgtca ttgttcttgg aggttgtgtg gagaggcatc accattaatc ttctgaacat 840
cagctatact aatcattaat tggaatcagc gactgcaaat tatggcagag gatgttggaa 900
atagtaccac cacattccta atccactatg ctttccaagc tgcagtaatt tgagttggag 960
acgggagttt tgctcattta ctcaggctct tggacaaaca aatgtgaaat cgcatatctg 1020
ctcaatccga catactaatc aaaggtcaag aatttttttt agagaagatg aaaaccataa 1080
tgaaagcatc taatgtttat agaaaattac caaaaatacc acatttatga aaaattatca 1140
aaaatacaat attcatagta tcacttttca tatttacaat aaccacgttt gttctcaatt 1200
ttaacgaaga acaaacgaca tttataatcc taagataatt ttttctaatt caaaaataat 1260
tttcgatttt caaaaaaaaa attgaaaaaa aaattgaaaa gaaaaattca aaacaaaatt 1320
atatgaaagt tcaaatttga aaaatgataa ttcaaaaaca taaaaaaata tatttttatt 1380
taaataatta tttattatat atatatagac catggagcaa gggggcgtgg gccccggggc 1440
ccaaactttt tttcccatat ataatgtcaa caaggacccg atttttagaa aaaaaaatag 1500
gtataaagga gtccaaaaaa ttcaaattag ttatatatgt atgtaaaaaa atattaaaat 1560
ttattttgcc caagggccta tagattcatt gggccgaccc tggggttggg gttgtgtgtg 1620
tgtcattcta taattaaccg gcaaaaactc caaaattttt atttaacaaa tgtataa 1677

<210> 304
<211> 24
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 1_Forward primer

<400> 304
gcggacatct acatttttga attg 24

<210> 305
<211> 28
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 1_Reverse primer

<400> 305
gctatttgac ttcttcatct gtgtgtct 28

<210> 306
<211> 22
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU locus 1_Probe

<400> 306
tttctccata ttgaccatca ta 22

<210> 307
<211> 39620
<212> DNA
<213> Artificial sequence

<220>
<223> contig of insert and flanking sequences of LBFDAU T-DNA Locus 2

<400> 307
attttagatt tagtcatatt tttaacttaa ttattaatta taataaatat ttttagtgat 60
ttagatgata aattttcatt gtcttgagaa taataaaaaa aaaatctaag gataatatca 120
tagttaaatt tatatgatat ttacttcagt aatattaaaa tattatatac atttttatta 180
tatttggttt agtaatatta aatggattct attttaaatt tcttatgaca atcaaaacca 240
cttagtgtga taatttctga aaaaaattgg caaaaaaatc aaaaatactt atcttattat 300
ttgtagtgat ttttctctct ctcatgttaa aattttgaat gtttaaagtc tttattatct 360
ttaataaata attagattaa atttttaata tataattacc cataatttaa aacaaatttc 420
attaatttta aaatcatcat tatctaaaaa gattatatat tatgttatcc aaaaatattt 480
tacatcataa tattttaaaa taaatataaa tttatgtata ttgttttatg tatatatgaa 540
tgtttttaag tttattttac ataatcaaat atattttaca aaaataattt ttatcatata 600
taaaatttaa catttaatta attattaaat atttcaaaag tatgaatata acttattctc 660
atggttttta attgataata tatctattta caatttttg taaaattatt aaacccgcaa 720
gtatggacaa aacacctagt atatatattt ggaacaaaga atacagacaa aacacctagt 780
atatatattt ggaacaaaaa atatacgtac atattttata tacatgaata acttatatat 840
cacttagaaa taggataatc aattgacatt aaactctctt aaattatata ttgtatagaa 900
gaactataga tatacgtata aaatatttat aaaagataac tacactatat atagaaacag 960
ataacgatac atccacgaaa attcttctgg aaaagaaaca gagtggtttc gcgtcagcac 1020
acctacgttg atcattggaa attggaatat tgaaacacgc ttcaaatcaa cgactattaa 1080
ttaccaatac accctggctt tggggtgaga gttgatcggt taattatcca atacatgccg 1140
ttggttaatt aggattatat aaaaaatcga tcatctatta gaatcgatta cggttaaata 1200
ggtataaaaa tggagagaat tgaatcagtt ataaatttgt tttcagttaa aatatttcta 1260
tgatcttcaa tcgatttcgg tattttatac tcaacatgga aaaaatttca aatgtatttc 1320
ttctaaaagc aaaagaatct ataaaaacta tcattttatc caaaacacca aaatagtctt 1380
ttacaatctt ttacagcctt cacataaacg aaaacaaaag tgaacaattt ctttttacag 1440
cctttacacc aaaaagacta cgatgaacta tgataaaatt tcataatcta aaaacattaa 1500
tgaggtaaag actctctcaa atgggatatt cttcgaaaat tttcataatc gaacgatata 1560
cttgaatttg caactcatga ccgaaattgt cccaatccat aatactcttt gacaccctat 1620
cagatcccaa cgttgtccct ggtttcgaaa ccaccatttc aaacatgaac atatcacaaa 1680
ataaacattt agacaccaaa tatctgctaa gcgcttacgt aagctcagct gacgctacct 1740
agcgttagct aacgtcacgt gacgctacct agcgttacgt aacgtcagct gaggctagct 1800
agctgaatta acgccgaatt aattcggggg atctggattt tagtactgga ttttggtttt 1860
aggaattaga aattttattg atagaagtat tttacaaata caaatacata ctaagggttt 1920
cttatatgct caacacatga gcgaaaccct ataggaaccc taattccctt atctgggaac 1980
tactcacaca ttattatgga gaaactcgag cttgtcgatc actcggtctt agctcccttt 2040
tgctttccat cggatggctt gatgtacttt tgcacgtaga agtttccgaa gaggaacaag 2100
agggagatca tgtagtagaa gaggatcttg atgagccatt gtggatatgg agcgttggtt 2160
ttcatatcgt agtaagcttg caccaagttg agcatgaact ggaacatctg gaattgggtg 2220

aggtatcttc cccagaagag gtacttgttc ttgagctttg gggaagatct caagcaagca 2280
gccaagaagt agtaagcgta catcaacacg tgcactccag agttgagagc agcactccaa 2340
taagcctctc ctcctggagc gtggtgagca atagcccacc agataaggga gatagaagag 2400
tggtggtaca cgtggaggaa agaaatctgt ctggtggatc tcttgaggat catgatcacg 2460
gtatccatga actccacgta cttggacatg tagaagaggt aaacgaggat agccatctcc 2520
ttgtgctttg ggttataagc gtttccccac aaggaatatc tccaggtgat agcttggtaa 2580
gcgataccca cgcacatgta aagagacaaa gcgaagcaga acaagttgtg caccaacacc 2640
aaagcttgca acaagaatgg ctcagaagct cttggcttga gatctctagc cttgatccaa 2700
agcaatcctc cgatcacgat ggtcaagtaa acagacactc ccaacacaat tggagttgga 2760
gaatcaacga gtggcaatcc cttagtagtt ggggtatcag tcaactcaac tccgaaagat 2820
cccaacaaag cgttcactcc ttgggaaacc tttccatcca actctccgta gaacctctca 2880
acaacttcca tggtttcttc taaagctgaa agtgaaccat tattacaact taacactcaa 2940
ctcacaagag gagaagcaac aaagcttatg taaggattta gtattaaggc caaaaaaaca 3000
cagatcaaat tcaattattg aagctttact tatcaagtta tcatataacc aatgaagacg 3060
gtaattcaaa agaaaaataa aagggtttgt agaataattg atacgtttac ctttgccgat 3120
tcagagacag tgaagcttaa acagtactgg ctatgaagaa attataatcg tgtaaaactt 3180
agtgagtgtg tatgaatgaa agtattgcaa aatcctcatt atatagacta catgcataac 3240
tagttgcatg taaatttgta gttttcttca ttattgcatc ctccaagtgg atgtcatggt 3300
tttacacatg gcttccatgc aaatcatttc caaaatattt ttaaactttc cacagggcat 3360
ccatgcatgc acctcaaaac ttgtgtgtgg taacattgtt gtcttgaaaa attactaaac 3420
cttttgtcca cgtgacgttc atgcacctca aatcttgtgt ggtaccatta ttatcctcaa 3480
gaattattga atgtttggtg tatatgccat ccatgcagca ttgcaacaat taaatctcca 3540
aaccttgtgg taccatattc actcacttta attctcctat agtagaaata ttagcaaata 3600
tttacatttc cagttgatta gtatatgtat ttagaagaca aaaataattt agaatcaatt 3660
aatcaacttg caaattgcta agtgttggca aacgttagca taaaaggtgt tataaattta 3720
gtaccaaata taaaaattta tcgcaaatca aatacataac acacatagta aaacaaaaac 3780
aaattacaag ggtttagacg tttagtggca atgtgtaaat ttgctgcagg agtgacgcta 3840
gctagcgtta cgtaacgtca gctgagccta ggtagcgtta gctaagctca cgtgacgcta 3900
cgtaggctta cgtaacgtca gctgaggcta cgtagcgtta gctaacgtca cgtgacgcta 3960
cgtaggctta cgtaatagtt actaatcagt gatcaggcgc gccattaatt tccaccttca 4020
cctacgatgg ggggcatcgc accggtgagt aatattgtac ggctaagagc gaatttggcc 4080
tgtagacctc aattgcgagc tttctaattt caaactattc gggcctaact tttggtgtga 4140
tgatgctgac tgtttcgacg ttaattgatc ctacactatg taggtcatat ccatcgtttt 4200
aatttttggc caccattcaa ttctgtcttg cctttaggga tgtgaatatg aacggccaag 4260
gtaagagaat aaaaataatc caaattaaag caagagaggc caagtaagat aatccaaatg 4320
tacacttgtc attgccaaaa ttagtaaaat actcggcata ttgtattccc acacattatt 4380
aaaataccgt atatgtattg gctgcatttg catgaataat actacgtgta agcccaaaag 4440
aacccacgtg tagcccatgc aaagttaaca ctcacgaccc cattcctcag tctccactat 4500
ataaacccac catccccaat ctcaccaaac ccaccacaca actcacaact cactctcaca 4560
ccttaaagaa ccaatcacca ccaaaaaatt tcacgatttg gaatttgatt cctgcgatca 4620
caggtatgac aggttagatt ttgttttgta tagttgtata catacttctt tgtgatgttt 4680
tgtttactta atcgaatttt tggagtgttt taaggtctct cgtttagaaa tcgtggaaaa 4740
tatcactgtg tgtgtgttct tatgattcac agtgtttatg ggtttcatgt tctttgtttt 4800
atcattgaat gggaagaaat ttcgttggga tacaaatttc tcatgttctt actgatcgtt 4860
attaggagtt tggggaaaaa ggaagagttt ttttggttgg ttcgagtgat tatgaggtta 4920
tttctgtatt tgatttatga gttaatggtc gttttaatgt tgtagacatg ggaaaaggat 4980
ctgagggaag atctgctgct agagagatga ctgctgaggc taacggagat aagagaaaga 5040
ccatcctcat tgagggagtg ttgtacgatg ctaccaactt caaacaccca ggaggttcca 5100
ttattaactt cctcaccgag ggagaagctg gagttgatgc tacccaagct tacagagagt 5160
tccatcagag atccggaaag gctgataagt acctcaagtc cctcccaaag ttggatgctt 5220
ctaaggtgga gtctaggttc tctgctaagg agcaggctag aagggacgct atgaccaggg 5280
attacgctgc tttcagagag gagttggttg ctgagggata cttcgatcca tctatcccac 5340
acatgatcta cagagtggtg gagattgtgg ctttgttcgc tttgtctttc tggttgatgt 5400
ctaaggcttc tccaacctct ttggttttgg gagtggtgat gaacggaatc gctcaaggaa 5460
gatgcggatg ggttatgcac gagatgggac acggatcttt cactggagtt atctggctcg 5520
atgataggat gtgcgagttc ttctacggag ttggatgtgg aatgtctgga cactactgga 5580
agaaccagca ctctaagcac cacgctgctc caaacagatt ggagcacgat gtggatttga 5640
acaccttgcc actcgttgct ttcaacgaga gagttgtgag gaaggttaag ccaggatctt 5700
tgttggcttt gtggctcaga gttcaggctt atttgttcgc tccagtgtct tgcttgttga 5760
tcggattggg atggaccttg tacttgcacc caagatatat gctcaggacc aagagacaca 5820
tggagtttgt gtggatcttc gctagatata tcggatggtt ctccttgatg ggagctttgg 5880
gatattctcc tggaacttct gtgggaatgt acctctgctc tttcggactt ggatgcatct 5940
acatcttcct ccaattcgct gtgtctcaca cccacttgcc agttaccaac ccagaggatc 6000
aattgcactg gcttgagtac gctgctgatc acaccgtgaa catctctacc aagtcttggt 6060
tggttacctg gtggatgtct aacctcaact tccaaatcga gcaccacttg ttcccaaccg 6120
ctccacaatt caggttcaag gagatctctc caagagttga ggctctcttc aagagacaca 6180
acctccctta ctacgatttg ccatacacct ctgctgtttc tactaccttc gctaacctct 6240
actctgttgg acactctgtt ggagctgata ccaagaagca ggattgactg ctttaatgag 6300

atatgcgaga cgcctatgat cgcatgatat ttgctttcaa ttctgttgtg cacgttgtaa 6360
aaaacctgag catgtgtagc tcagatcctt accgccggtt tcggttcatt ctaatgaata 6420
tatcacccgt tactatcgta tttttatgaa taatattctc cgttcaattt actgattgtc 6480
tacgtaggct cagctgagct tacctaaggc tacgtaggct cacgtgacgt tacgtaaggc 6540
tacgtagcgt cacgtgagct tacctaactc tagctagcct cacgtgacct tagctaacac 6600
taggtagcgt cagctcgacg gcccggactg tatccaactt ctgatctttg aatctctctg 6660
ttccaacatg ttctgaagga gttctaagac ttttcagaaa gcttgtaaca tgctttgtag 6720
actttctttg aattactctt gcaaactctg attgaaccta cgtgaaaact gctccagaag 6780
ttctaaccaa attccgtctt gggaaggccc aaaatttatt gagtacttca gtttcatgga 6840
cgtgtcttca aagatttata acttgaaatc ccatcatttt taagagaagt tctgttccgc 6900
aatgtcttag atctcattga aatctacaac tcttgtgtca gaagttcttc cagaatcaac 6960
ttgcatcatg gtgaaaatct ggccagaagt tctgaacttg tcatatttct taacagttag 7020
aaaaatttct aagtgtttag aattttgact tttccaaagc aaacttgact tttgactttc 7080
ttaataaaac aaacttcata ttctaacatg tcttgatgaa atgtgattct tgaaatttga 7140
tgttgatgca aaagtcaaag tttgactttt cagtgtgcaa ttgaccattt tgctcttgtg 7200
ccaattccaa acctaaattg atgtatcagt gctgcaaact tgatgtcatg gaagatctta 7260
tgagaaaatt cttgaagact gagaggaaaa attttgtagt acaacacaaa gaatcctgtt 7320
tttcatagtc ggactagaca cattaacata aaacaccact tcattcgaag agtgattgaa 7380
gaaggaaatg tgcagttacc tttctgcagt tcataagagc aacttacaga cacttttact 7440
aaaatactac aaagaggaag attttaacaa cttagagaag taatgggagt taaagagcaa 7500
cacattaagg gggagtgtta aaattaatgt gttgtaacca ccactacctt tagtaagtat 7560
tataagaaaa ttgtaatcat cacattataa ttattgtcct tatttaaaat tatgataaag 7620
ttgtatcatt aagattgaga aaaccaaata gtcctcgtct tgatttttga attattgttt 7680
tctatgttac ttttcttcaa gcctatataa aaactttgta atgctaaatt gtatgctgga 7740
aaaaaatgtg taatgaattg aatagaaatt atggtatttc aaagtccaaa atccatcaat 7800
agaaatttag tacaaaacgt aactcaaaaa tattctctta ttttaaattt tacaacaata 7860
taaaaatatt ctcttatttt aaattttaca ataatataat ttatcacctg tcacctttag 7920
aataccacca acaatattaa tacttagata ttttattctt aataattttg agatctctca 7980
atatatctga tatttatttt atatttgtgt catattttct tatgttttag agttaaccct 8040
tatatcttgg tcaaactagt aattcaatat atgagtttgt gaaggacaca ttgacatctt 8100
gaaacattgg ttttaacctt gttggaatgt taaaggtaat aaaacattca gaattatgac 8160
catctattaa tatacttcct ttgtctttta aaaaagtgtg catgaaaatg ctctatggta 8220
agctagagtg tcttgctggc ctgtgtatat caattccatt tccagatggt agaaactgcc 8280
actacgaata attagtcata agacacgtat gttaacacac gtccccttgc atgtttttttg 8340
ccatatattc cgtctctttc tttttcttca cgtataaaac aatgaactaa ttaatagagc 8400
gatcaagctg aacagttctt tgctttcgaa gttgccgcaa cctaaacagg tttttccttc 8460
ttctttcttc ttattaacta cgaccttgtc ctttgcctat gtaaaattac taggttttca 8520
tcagttacac tgattaagtt cgttatagtg gaagataaaa tgccctcaaa gcattttgca 8580
ggatatcttt gatttttcaa agatatggaa ctgtagagtt tgatagtgtt cttgaatgtg 8640
gttgcatgaa gtttttttgg tctgcatgtt attttttcct cgaaatatgt tttgagtcca 8700
acaagtgatt cacttgggat tcagaaagtt gttttctcaa tatgtaacag ttttttttcta 8760
tggagaaaaa tcatagggac cgttggtttt ggcttcttta attttgagct cagattaaac 8820
ccattttacc cggtgttctt ggcagaattg aaaacagtac gtagtaccgc gcctaccatg 8880
tgtgttgaga ccgagaacaa cgatggaatc cctactgtgg agatcgcttt cgatggagag 8940
agagaaagag ctgaggctaa cgtgaagttg tctgctgaga agatggaacc tgctgctttg 9000
gctaagacct tcgctagaag atacgtggtt atcgagggag ttgagtacga tgtgaccgat 9060
ttcaaacatc ctggaggaac cgtgattttc tacgctctct ctaacactgg agctgatgct 9120
actgaggctt tcaaggagtt ccaccacaga tctagaaagg ctaggaaggc tttggctgct 9180
ttgccttcta gacctgctaa gaccgctaaa gtggatgatg ctgagatgct ccaggatttc 9240
gctaagtgga gaaaggagtt ggagagggac ggattcttca agccttctcc tgctcatgtt 9300
gcttacagat tcgctgagtt ggctgctatg tacgctttgg gaacctactt gatgtacgct 9360
agatacgttg tgtcctctgt gttggtttac gcttgcttct tcggagctag atgtggatgg 9420
gttcaacacg agggaggaca ctcttctttg accggaaaca tctggtggga taagagaatc 9480
caagctttca ctgctggatt cggattggct ggatctggag atatgtggaa ctccatgcac 9540
aacaagcacc acgctactcc tcaaaaagtg aggcacgata tggatttgga taccactcct 9600
gctgttgctt tcttcaacac cgctgtggag gataatagac ctaggggatt ctctaagtac 9660
tggctcagat tgcaagcttg gaccttcatt cctgtgactt ctggattggt gttgctcttc 9720
tggatgttct tcctccaccc ttctaaggct ttgaagggag gaaagtacga ggagcttgtg 9780
tggatgttgg ctgctcacgt gattagaacc tggaccatta aggctgttac tggattcacc 9840
gctatgcaat cctacggact cttcttggct acttcttggg tttccggatg ctacttgttc 9900
gctcacttct ctacttctca cacccacttg gatgttgttc ctgctgatga gcacttgtct 9960
tgggttaggt acgctgtgga tcacaccatt gatatcgatc cttctcaggg atgggttaac 10020
tggttgatgg gatacttgaa ctgccaagtg attcaccacc tcttcccttc tatgcctcaa 10080
ttcagacaac ctgaggtgtc cagaagattc gttgctttcg ctaagaagtg gaacctcaac 10140
tacaaggtga tgacttatgc tggagcttgg aaggctactt tgggaaacct cgataatgtg 10200
ggaaagcact actacgtgca cggacaacac tctggaaaga ccgcttgatt aatgaaggcc 10260
gcctcgaccg taccccctgc agatagacta tactatgttt tagcctgcct gctggctagc 10320
tactatgtta tgttatgttg taaaataaac acctgctaag gtatatctat ctatatttta 10380

gcatggcttt ctcaataaat tgtctttcct tatcgtttac tatcttatac ctaataatga 10440
aataataata tcacatatga ggaacggggc aggtttaggc atatatatac gagtgtaggg 10500
cggagtgggg ctacgtagcg tcacgtgacg ttacctaagc ctaggtagcc tcagctgacg 10560
ttacgtaacg ctaggtaggc tcagctgaca cgggcaggac atagggacta ctacaagcat 10620
agtatgcttc agacaaagag ctaggaaaga actcttgatg gaggttaaga gaaaaaagtg 10680
ctagaggggc atagtaatca aacttgtcaa aaccgtcatc atgatgaggg atgacataat 10740
ataaaaagtt gactaaggtc ttggtagtac tctttgatta gtattatata ttggtgagaa 10800
catgagtcaa gaggagacaa gaaaccgagg aaccatagtt tagcaacaag atggaagttg 10860
caaagttgag ctagccgctc gattagttac atctcctaag cagtactaca aggaatggtc 10920
tctatacttt catgtttagc acatggtagt gcggattgac aagttagaaa cagtgcttag 10980
gagacaaaga gtcagtaaag gtattgaaag agtgaagttg atgctcgaca ggtcaggaga 11040
agtccctccg ccagatggtg actaccaagg ggttggtatc agctgagacc caaataagat 11100
tcttcggttg aaccagtggt tcgaccgaga ctcttagggt gggatttcac tgtaagattt 11160
gtgcattttg ttgaatataa attgacaatt tttttatttt aattatagat tatttagaat 11220
gaattacata tttagtttct aacaaggata gcaatggatg ggtatgggta caggttaaac 11280
atatctatta cccacccatc tagtcgtcgg gttttacacg tacccacccg tttacataaa 11340
ccagaccgga atttaaaacc gtacccgtcc gttagcgggt ttcagattta cccgtttaat 11400
cgggtaaaac ctgattacta aatatatatt ttttatttga taaacaaaac aaaaatgtta 11460
atattttcat attggatgca attttaagaa acacatattc ataaatttcc atatttgtag 11520
gaaaataaaa agaaaaatat attcaagaac acaaatttca ccgacatgac ttttattaca 11580
gagttggaat tagatctaac aattgaaaaa ttaaaattaa gatagaatat gttgaggaac 11640
atgacatagt ataatgctgg gttacccgtc gggtaggtat cgaggcggat actactaaat 11700
ccatcccact cgctatccga taatcactgg tttcgggtat acccattccc gtcaacaggc 11760
ctttttaacc ggataatttc aacttatagt gaatgaattt tgaataaata gttagaatac 11820
caaaatcctg gattgcattt gcaatcaaat tttgtgaacc gttaaatttt gcatgtactt 11880
gggatagata taatagaacc gaattttcat tagtttaatt tataacttac tttgttcaaa 11940
gaaaaaaaat atctatccaa tttacttata ataaaaaata atctatccaa gttacttatt 12000
ataatcaact tgtaaaaagg taagaataca aatgtggtag cgtacgtgtg attatatgtg 12060
acgaaatgtt atatctaaca aaagtccaaa ttcccatggt aaaaaaaatc aaaatgcatg 12120
gcaggctgtt tgtaaccttg gaataagatg ttggccaatt ctggagccgc cacgtacgca 12180
agactcaggg ccacgttctc ttcatgcaag gatagtagaa caccactcca cccacctcct 12240
atattagacc tttgcccaac cctccccaac tttcccatcc catccacaaa gaaaccgaca 12300
tttttatcat aaatctggtg cttaaacact ctggtgagtt ctagtacttc tgctatgatc 12360
gatctcatta ccatttctta aatttctctc cctaaatatt ccgagttctt gatttttgat 12420
aacttcaggt tttctctttt tgataaatct ggtctttcca ttttttttt ttgtggttaa 12480
tttagtttcc tatgttcttc gattgtatta tgcatgatct gtgtttggat tctgttagat 12540
tatgtattgg tgaatatgta tgtgtttttg catgtctggt tttggtctta aaaatgttca 12600
aatctgatga tttgattgaa gctttttag tgttggtttg attcttctca aaactactgt 12660
taatttacta tcatgttttc caactttgat tcatgatgac acttttgttc tgctttgtta 12720
taaaattttg gttggtttga ttttgtaatt atagtgtaat tttgttagga atgaacatgt 12780
tttaatactc tgttttcgat ttgtcacaca ttcgaattat taatcgataa tttaactgaa 12840
aattcatggt tctagatctt gttgtcatca gattatttgt ttcgataatt catcaaatat 12900
gtagtccttt tgctgatttg cgactgtttc attttttctc aaaattgttt tttgttaagt 12960
ttatctaaca gttatcgttg tcaaaagtct ctttcatttt gcaaaatctt cttttttttt 13020
ttgtttgtaa ctttgttttt taagctacac atttagtctg taaaatagca tcgaggaaca 13080
gttgtcttag tagacttgca tgttcttgta acttctattt gtttcagttt gttgatgact 13140
gctttgattt tgtaggtcaa aggcgcaccc taccatggat gcttataacg ctgctatgga 13200
taagattgga gctgctatca tcgattggag tgatccagat ggaaagttca gagctgatag 13260
ggaggattgg tggttgtgcg atttcagatc cgctatcacc attgctctca tctacatcgc 13320
tttcgtgatc ttgggatctg ctgtgatgca atctctccca gctatggacc catacccctat 13380
caagttcctc tacaacgtgt ctcaaatctt cctctgcgct tacatgactg ttgaggctgg 13440
attcctcgct tataggaacg gatacaccgt tatgccatgc aaccacttca acgtgaacga 13500
tccaccagtt gctaacttgc tctggctctt ctacatctcc aaagtgtggg atttctggga 13560
taccatcttc attgtgctcg gaaagaagtg gagacaactc tctttcttgc acgtgtacca 13620
ccacaccacc atcttcctct tctactggtt gaacgctaac gtgctctacg atggagatat 13680
cttcttgacc atcctcctca acggattcat tcacaccgtg atgtacacct actacttcat 13740
ctgcatgcac accaaggatt ctaagaccgg aaagtctttg ccaatctggt ggaagtcatc 13800
tttgaccgct ttccaactct tgcaattcac catcatgatg tcccaagcta cctacttggt 13860
tttccacgga tgcgataagg tttccctcag aatcaccatc gtgtacttcg tgtacattct 13920
ctcccttttc ttcctcttcg ctcagttctt cgtgcaatcc tacatggctc caaagaagaa 13980
gaagtccgct tgatgttaat gaaggccgca gatatcagat ctggtcgacc tagaggatcc 14040
ccggccgcaa agataataac aaaagcctac tatataacgt acatgcaagt attgtatgat 14100
attaatgttt ttacgtacgt gtaaacaaaa ataattacgt ttgtaacgta tggtgatgat 14160
gtggtgcact aggtgtaggc cttgtattaa taaaaagaag tttgttctat atagagtggt 14220
ttagtacgac gatttattta ctagtcggat tggaatagag aaccgaattc ttcaatcctt 14280
gcttttgatc aagaattgaa accgaatcaa atgtaaaagt tgatatattt gaaaaacgta 14340
ttgagcttat gaaaatgcta atactctcat ctgtatggaa aagtgacttt aaaaccgaac 14400
ttaaaagtga caaaagggga atatcgcatc aaaccgaatg aaaccgatct acgtaggctc 14460

agctgagctt agctaagcct acctagcctc acgtgagatt atgtaaggct aggtagcgtc 14520
acgtgacgtt acctaacact agctagcgtc agctgagctt agctaaccct acgtagcctc 14580
acgtgagctt acctaacgct acgtagcctc acgtgactaa ggatgaccta cccattcttg 14640
agacaaatgt tacattttag tatcagagta aaatgtgtac ctataactca aattcgattg 14700
acatgtatcc attcaacata aaattaaacc agcctgcacc tgcatccaca tttcaagtat 14760
tttcaaaccg ttcggctcct atccaccggg tgtaacaaga cggattccga atttggaaga 14820
ttttgactca aattcccaat ttatattgac cgtgactaaa tcaactttaa cttctataat 14880
tctgattaag ctcccaattt atattcccaa cggcactacc tccaaaattt atagactctc 14940
atcccctttt aaaccaactt agtaaacgtt ttttttttaa ttttatgaag ttaagttttt 15000
accttgtttt taaaaagaat cgttcataag atgccatgcc agaacattag ctacacgtta 15060
cacatagcat gcagccgcgg agaattgttt ttcttcgcca cttgtcactc ccttcaaaca 15120
cctaagagct tctctctcac agcacacaca tacaatcaca tgcgtgcatg cattattaca 15180
cgtgatcgcc atgcaaatct cctttatagc ctataaatta actcatcggc ttcactcttt 15240
actcaaacca aaactcatca atacaaacaa gattaaaaac atttcacgat ttggaatttg 15300
attcctgcga tcacaggtat gacaggttag attttgtttt gtatagttgt atacatactt 15360
ctttgtgatg ttttgtttac ttaatcgaat ttttggagtg ttttaaggtc tctcgtttag 15420
aaatcgtgga aaatatcact gtgtgtgtgt tcttatgatt cacagtgttt atgggtttca 15480
tgttctttgt tttatcattg aatgggaaga aatttcgttg ggatacaaat ttctcatgtt 15540
cttactgatc gttattagga gtttggggaa aaaggaagag ttttttttggt tggttcgagt 15600
gattatgagg ttatttctgt atttgattta tgagttaatg gtcgttttaa tgttgtagac 15660
cgccatggct attttgaacc ctgaggctga ttctgctgct aacctcgcta ctgattctga 15720
ggctaagcaa agacaattgg ctgaggctgg atacactcac gttgagggtg ctcctgctcc 15780
tttgcctttg gagttgcctc acttctctct cagagatctc agagctgcta ttcctaagca 15840
ctgcttcgag agatctttcg tgacctccac ctactacatg atcaagaacg tgttgacttg 15900
cgctgctttg ttctacgctg ctaccttcat tgatagagct ggagctgctg cttatgtttt 15960
gtggcctgtg tactggttct tccagggatc ttacttgact ggagtgtggg ttatcgctca 16020
cgagtgtgga caccaggctt attgctcttc tgaggtggtg aacaacttga ttggactcgt 16080
gttgcactct gctttgttgg tgccttacca ctcttggaga atctctcaca gaaagcacca 16140
ctccaacact ggatcttgcg agaacgatga ggttttcgtt cctgtgacca gatctgtgtt 16200
ggcttcttct tggaacgaga ccttggagga ttctcctctc taccaactct accgtatcgt 16260
gtacatgttg gttgttggat ggatgcctgg atacctcttc ttcaacgcta ctggacctac 16320
taagtactgg ggaaagtcta ggtctcactt caacccttac tccgctatct atgctgatag 16380
ggagaggtgg atgatcgtgc tctccgatat tttcttggtg gctatgttgg ctgttttggc 16440
tgctttggtg cacactttct ccttcaacac gatggtgaag ttctacgtgg tgccttactt 16500
cattgtgaac gcttacttgg tgttgattac ctacctccaa cacaccgata cctacatccc 16560
tcacttcaga gagggagagt ggaattggtt gagaggagct ttgtgcactg tggatagatc 16620
atttggtcca ttcctcgatt ctgtggtgca tagaatcgtg gatacccacg tttgccacca 16680
tatcttctcc aagatgcctt tctatcactg cgaggaggct accaacgcta ttaagcctct 16740
cctcggaaag ttctacttga aggatactac tcctgttcct gttgctctct ggagatctta 16800
cacccactgc aagttcgttg aggatgatgg aaaggtggtg ttctacaaga acaagttata 16860
gttaatgaat aattgattgg ttcgagtatt atggcattgg gaaaactgtt tttcttgtac 16920
catttgttgt gcttgtaatt tactgtgttt tttattcggt tttcgctatc gaactgtgaa 16980
atggaaatgg atggagaaga gttaatgaat gatatggtcc ttttgttcat tctcaaatta 17040
atattatttg ttttttctct tatttgttgt gtgttgaatt tgaaattata agagatatgc 17100
aaacattttg ttttgagtaa aaatgtgtca aatcgtggcc tctaatgacc gaagttaata 17160
tgaggagtaa aacacttgta gttgtaccat tatgcttatt cactaggcaa caaatatatt 17220
ttcagaccta gaaaagctgc aaatgttact gaatacaagt atgtcctctt gtgttttaga 17280
catttatgaa ctttccttta tgtaattttc cagaatcctt gtcagattct aatcattgct 17340
ttataattat agttatactc atggatttgt agttgagtat gaaaatattt tttaatgcat 17400
tttatgactt gccaattgat tgacaacatg catcaatcta gctagcctca gctgacgtta 17460
cgtaacgcta ggtagcgtca cgtgacgtta gctaacgcta ggtagcgtca gctgagctta 17520
cgtaagcgca cagatgaata ctagctgttg ttcacagttc tagtgtctcc tcattacgtg 17580
aattcaagct acgatcacta tctcaactcc tacataaaca tcagaatgct acaaaactat 17640
gcacaaaaac aaaagctaca tctaatacgt gaatcaatta ctctcatcac aagaaagaag 17700
atttcaatca ccgtcgagaa ggaggattca gttaattgaa tcaaagttcc gatcaaactc 17760
gaagactggt gagcacgagg acgacgaaga agagtgtctc gaagatacaa caagcaagaa 17820
atctactgag tgacctcctg aagttattgg cgcgattgag agaatcaatc cgaattaatt 17880
tcggggaaaa agataaatta gatactaagc gatgggcttg ggctgggcta agaaacaggt 17940
ggcaattggg ctggaggacc ccgcgattca tagcttccga tagcccaaaa aaaaacggat 18000
aacatattta tcgggtattt gaatttcagt gaaataagat attttctttt tgttaggaaa 18060
attttagaaa ataatggaaa ttaaatagcg attatgttac aagatacgat cagcatcggg 18120
cagtgcaaaa tgctatagct tcccaagatt tgatcctttt gggttatctc ctaatgacaa 18180
ttagtttagg attttgaaac ttatattaat actattatcc gacaacactt gtttcagctt 18240
cttattttaa catttttttgt ttttttctat tcttcttccc atcagcattt tctttttaaa 18300
aaattgaata ctttaacttt ttaaaaattt cacaatgatc agatgatatt atggaagatc 18360
tcaagagtta aatgtatcca tcttggggca ttaaaaccgg tgtacgggat gataaataca 18420
gactttatat catatgatag ctcagtaatt catatttatc acgttgctaa aaaaattata 18480
aggtactagt agtcaacaaa atcaattaaa gagaaagaaa gaaacgcatg tgaagagagt 18540

```
ttacaactgg aaaagtaaaa taaaaattaa cgcatgttga atgctgacat gtcagtatgt  18600
ccatgaatcc acgtatcaag cgccattcat cgatcgtctt cctctttcta aatgaaaaca  18660
acttcacaca tcacaacaaa caatacacac aagacccccct ctctctcgtt gtctctctgc  18720
cagcgaccaa atcgaagctt gagaagaaca agaaggggtc aaaccatggc ttctacatct  18780
gctgctcaag acgctgctcc ttacgagttc ccttctctca ctgagatcaa gagggctctt  18840
ccttctgagt gtttcgaggc ttctgttcct ctttctctct actacaccgc tagatctctt  18900
gctcttgctg gatctctcgc tgttgctctc tcttacgcta gagctttgcc tcttgttcag  18960
gctaacgctc ttcttgatgc tactctctgc actggatacg ttcttctcca gggaatcgtt  19020
ttctggggat tcttcaccgt tggtcacgat tgtggacacg gagctttctc tagatctcac  19080
gtgctcaact tctctgttgg aaccctcatg cactctatca tccttacccc tttcgagtct  19140
tggaagctct ctcacagaca ccaccacaag aacaccggaa acatcgataa ggacgagatc  19200
ttctaccctc aaagagaggc tgattctcac cctgtttcta gacaccttgt gatgtctctt  19260
ggatctgctt ggttcgctta ccttttcgct ggattccctc ctagaaccat gaaccacttc  19320
aacccttggg aggctatgta tgttagaaga gtggctgctg tgatcatctc tctcggagtt  19380
cttttcgctt tcgctggact ctactcttac ctcaccttcg ttcttggatt caccactatg  19440
gctatctact acttcggacc tctcttcatc ttcgctacca tgcttgttgt taccactttc  19500
ctccaccaca acgatgagga gacaccttgg tacgctgatt ctgagtggac ttacgtgaag  19560
ggaaacctct cttctgtgga cagatcttac ggtgctctca tcgacaacct tagccacaac  19620
atcggaactc accagatcca ccacctcttc cctatcatcc ctcactacaa gctcaacgat  19680
gctactgctg ctttcgctaa ggctttccct gagcttgtta ggaaaaacgc tgctcctatc  19740
atcccaactt tcttcaggat ggctgctatg tacgctaagt acggagttgt tgacactgat  19800
gctaagacct tcactctcaa ggaggctaag gctgctgcta agactaagtc atcttgatga  19860
ttaatgaata attgattgta catactatat tttttgttta ccttgtgtta gtttaatgtt  19920
cagtgtcctc tctttattgt ggcacgtctc tttgttgtat gttgtgtcta tacaaagttg  19980
aaataatgga aagaaaagga agagtgtaat ttgttttgtt ttaagtgttt ataaatatat  20040
atatataggt catttagata gttctaggtt tctataaaac tctctctctg gaagtagaat  20100
ctgtttttga gaggatccag ttgcctacta atctccccca aaacccttca agcttaacct  20160
tcctcttcac aacaacagag gaaacacatc tcttgagctc tgagttctct tctttgagca  20220
tgtctatcgc taaactcatc tgccttatag cttccctctt ctcttcatct ctctctctca  20280
ccatttcgct gtaaaactta ttctcctccc tcagcctctc tatctcttcc ttcagcatct  20340
cacaattccc accataatcg actgaggatg attcaccgtc atcaacttca gactcagcgt  20400
tgtagtcgtc atgagtctca caagccttgg accaagaaga ctcatcatcg caagttgatg  20460
atttatcatg atgcttctct gagccgtgtt tgctacgtag cgtcacgtga cgttacctaa  20520
gcctaggtag cctcagctga cgttacgtaa cgctaggtag gctcagctga ctgcagcaaa  20580
tttacacatt gccactaaac gtctaaaccc ttgtaatttg tttttgtttt actatgtgtg  20640
ttatgtattt gatttgcgat aaatttttat atttggtact aaatttataa caccttttat  20700
gctaacgttt gccaacactt agcaatttgc aagttgatta attgattcta aattattttt  20760
gtcttctaaa tacatatact aatcaactgg aaatgtaaat atttgctaat atttctacta  20820
taggagaatt aaagtgagtg aatatggtac cacaaggttt ggagatttaa ttgttgcaat  20880
gctgcatgga tggcatatac accaaacatt caataattct tgaggataat aatggtacca  20940
cacaagattt gaggtgcatg aacgtcacgt ggacaaaagg tttagtaatt tttcaagaca  21000
acaatgttac cacacacaag ttttgaggtg catgcatgga tgccctgtgg aaagtttaaa  21060
aatattttgg aaatgatttg catggaagcc atgtgtaaaa ccatgacatc cacttggagg  21120
atgcaataat gaagaaaact acaaatttac atgcaactag ttatgcatgt agtctatata  21180
atgaggattt tgcaatactt tcattcatac acactcacta agttttacac gattataatt  21240
tcttcatagc cagtactgtt taagcttcac tgtctctgaa tcggcaaagg taaacgtatc  21300
aattattcta caaacccttt tatttttctt ttgaattacc gtcttcattg gttatatgat  21360
aacttgataa gtaaagcttc aataattgaa tttgatctgt gttttttttgg ccttaatact  21420
aaatccttac ataagctttg ttgcttctcc tcttgtgagt tgagtgttaa gttgtaataa  21480
tggttcactt tcagctttag aagaaacgcg ccttccatgg ctacaaagga ggcttacgtt  21540
ttcccaactc tcaccgagat caagagatct ctcccaaagg attgcttcga ggcttctgtg  21600
cctttgtctc tctactacac tgtgagatgc ttggttattg ctgtggcttt gaccttcgga  21660
ttgaactacg ctagagcttt gccagaggtt gagtctttct gggctttgga tgctgctttg  21720
tgcactggat atatcctcct ccagggaatt gtgttctggg gattcttcac tgttggacac  21780
gatgctggac acggagcttt ctctagatac cacctcttga acttcgttgt gggaaccttc  21840
atgcactctc tcatcttgac cccattcgag tcttggaagt tgacccacag acaccaccac  21900
aagaacaccg gaaacatcga tagagatgag gtgttctacc cacagagaaa ggctgatgat  21960
cacccattgt ccaggaactt gatcttggct ttgggagctg cttggcttgc ttatttggtg  22020
gagggattcc caccaagaaa ggtgaaccac ttcaacccat tcgagccact tttgtgaga  22080
caagtgtccg ctgtggttat ctctttgctc gctcacttct tcgttgctgg actctctatc  22140
tacttgtctc tccagttggg acttaagacc atggctatct actactacgg accagttttc  22200
gtgttcggat ctatgttggt gattaccacc ttcttgcacc acaacgatga ggagactcca  22260
tggtatgctg attctgagtg gacttacgtg aagggaaact tgtcctctgt ggatagatct  22320
tacggtgctc tcatcgataa cctctcccac aacatcggaa ctcaccagat ccaccacctc  22380
ttcccaatta tcccacacta caagctcaag aaggctactg ctgctttcca ccaagctttc  22440
ccagagcttg tgagaaagtc cgatgagcca atcatcaagg ctttcttcag agtgggaagg  22500
ttgtatgcta actacggagt ggttgatcaa gaggctaagc tcttcacttt gaaggaggct  22560
aaggctgcta ctgaagctgc tgctaagacc aagtctacct gattaatgaa tcgacaagct  22620
```

cgagtttctc cataataatg tgtgagtagt tcccagataa gggaattagg gttcctatag 22680
ggtttcgctc atgtgttgag catataagaa acccttagta tgtatttgta tttgtaaaat 22740
acttctatca ataaaatttc taattcctaa aaccaaaatc cagtactaaa atccagatcc 22800
cccgaattaa ttcggcgtta attcagctac gtaggctcag ctgagcttac ctaaggctac 22860
gtaggctcac gtgacgttac gtaaggctac gtagcgtcac gtgagcttac ctaactctag 22920
ctagcctcac gtgaccttag ctaacactag gtagcgtcag cacagatgaa tactagctgt 22980
tgttcacagt tctagtgtct cctcattacg tgaattcaag ctacgatcac tatctcaact 23040
cctacataaa catcagaatg ctacaaaact atgcacaaaa acaaaagcta catctaatac 23100
gtgaatcaat tactctcatc acaagaaaga agatttcaat caccgtcgag aaggaggatt 23160
cagttaattg aatcaaagtt ccgatcaaac tcgaagactg gtgagcacga ggacgacgaa 23220
gaagagtgtc tcgaagatac aacaagcaag aaatctactg agtgacctcc tgaagttatt 23280
ggcgcgattg agagaatcaa tccgaattaa tttcggggaa aaagataaat tagatactaa 23340
gcgatgggct tgggctgggc taagaaacag gtggcaattg ggctggagga ccccgcgatt 23400
catagcttcc gatagcccaa aaaaaaacgg ataacatatt tatcgggtat ttgaatttca 23460
gtgaaataag atattttctt tttgttagga aaattttaga aaataatgga aattaaatag 23520
cgattatgtt acaagatacg atcagcatcg ggcagtgcaa aatgctatag cttcccaaga 23580
tttgatcctt ttgggttatc tcctaatgac aattagttta ggattttgaa acttatatta 23640
atactattat ccgacaacac ttgtttcagc ttcttatttt aacatttttt gtttttttct 23700
attcttcttc ccatcagcat tttcttttta aaaaattgaa tactttaact ttttaaaaat 23760
ttcacaatga tcagatgata ttatggaaga tctcaagagt taaatgtatc catcttgggg 23820
cattaaaacc ggtgtacggg atgataaata cagactttat atcatatgat agctcagtaa 23880
ttcatattta tcacgttgct aaaaaaatta taaggtacta gtagtcaaca aaatcaatta 23940
aagagaaaga aagaaacgca tgtgaagaga gtttacaact ggaaaagtaa aataaaaatt 24000
aacgcatgtt gaatgctgac atgtcagtat gtccatgaat ccacgtatca agcgccattc 24060
atcgatcgtc ttcctctttc taaatgaaaa caacttcaca catcacaaca aacaatacac 24120
acaagacccc ctctctctcg ttgtctctct gccagcgacc aaatcgaagc ttgagaagaa 24180
caagaagggg tcaaaccatg ggaaaaggat ctgagggaag atctgctgct agagagatga 24240
ctgctgaggc taacggagat aagagaaaga ccatcctcat tgagggagtg ttgtacgatg 24300
ctaccaactt caaacaccca ggaggttcca ttattaactt cctcaccgag ggagaagctg 24360
gagttgatgc tacccaagct tacagagagt tccatcagag atccggaaag gctgataagt 24420
acctcaagtc cctcccaaag ttggatgctt ctaaggtgga gtctaggttc tctgctaagg 24480
agcaggctag aagggacgct atgaccaggg attacgctgc tttcagagag gagttggttg 24540
ctgagggata cttcgatcca tctatcccac acatgatcta cagagtggtg gagattgtgg 24600
ctttgttcgc tttgtctttc tggttgatgt ctaaggcttc tccaacctct ttggttttgg 24660
gagtggtgat gaacggaatc gctcaaggaa gatgcggatg ggttatgcac gagatgggac 24720
acggatcttt cactggagtt atctggctcg atgataggat gtgcgagttc ttctacggag 24780
ttggatgtgg aatgtctgga cactactgga agaaccagca ctctaagcac cacgctgctc 24840
caaacagatt ggagcacgat gtggatttga acaccttgcc actcgttgct ttcaacgaga 24900
gagttgtgag gaaggttaag ccaggatctt tgttggcttt gtggctcaga gttcaggctt 24960
atttgttcgc tccagtgtct tgcttgttga tcggattggg atggaccttg tacttgcacc 25020
caagatatat gctcaggacc aagagacaca tggagtttgt gtggatcttc gctagatata 25080
tcggatggtt ctccttgatg ggagctttgg gatattctcc tggaacttct gtgggaatgt 25140
acctctgctc tttcggactt ggatgcatct acatcttcct ccaattcgct gtgtctcaca 25200
cccacttgcc agttaccaac ccagaggatc aattgcactg gcttgagtac gctgctgatc 25260
acaccgtgaa catctctacc aagtcttggt tggttacctg gtggatgtct aacctcaact 25320
tccaaatcga gcaccacttg ttcccaaccg ctccacaatt caggttcaag gagatctctc 25380
caagagttga ggctctcttc aagagacaca acctccctta ctacgatttg ccatacacct 25440
ctgctgtttc tactaccttc gctaacctct actctgttgg acactctgtt ggagctgata 25500
ccaagaagca ggattgatga ttaatgaata attgattgta catactatat tttttgttta 25560
ccttgtgtta gtttaatgtt cagtgtcctc tctttattgt ggcacgtctc tttgttgtat 25620
gttgtgtcta tacaaagttg aaataatgga aagaaaagga agagtgtaat ttgttttgtt 25680
ttaagtgttt ataaatatat atatataggt catttagata gttctaggtt tctataaaac 25740
tctctctctg gaagtagaat ctgtttttga gaggatccag ttgcctacta atctccccca 25800
aaacccttca agcttaacct tcctcttcac aacaacagag gaaacacatc tcttgagctc 25860
tgagttctct tctttgagca tgtctatcgc taaactcatc tgccttatag cttccctctt 25920
ctcttcatct ctctctctca ccatttcgct gtaaaactta ttctcctccc tcagcctctc 25980
tatctcttcc ttcagcatct cacaattccc accataatcg actgaggatg attcaccgtc 26040
atcaacttca gactcagcgt tgtagtcgtc atgagtctca caagccttgg accaagaaga 26100
ctcatcatcg caagttgatg atttatcatg atgcttctct gagccgtgtt tgctacctag 26160
agtcagctga gcttagctaa cgctagctag tgtcagctga cgttacgtaa ggctaactag 26220
cgtcacgtga ccttacgtaa cgctacgtag gctcagctga gcttagctaa ccctagctag 26280
tgtcacgtga gcttacgcta ctatagaaaa tgtgttatat cgacatgacc agacaaaggg 26340
gcaacagtta acaaaacaat taattctttc atttgagatt aaggaaggta aggtactaaa 26400
aagattaaaa aaaatgagct tatctctttg tttctgtaat aataatataa gtgtgataaa 26460
cttttaatat aataattgta attaggtttt ctacagatga gcaccactca gagacaagat 26520
aagaagaaaa caattttgtt aaacatgatt atagaaactt ttagttaagt cttgaagtat 26580
caatataaca aaaaaaagta cacacgacta tgacaataaa cccactaccg tcaggttatc 26640
atttcgatga aatgttttga tatcattaaa tataacagtc acaaaaaatc atctaattat 26700

aacaatataa cttatacata tatttaacta aaaacttaga gtttttgtaa tgattctaat 26760
tgatgattag agtttataga aatacaatta aataaaaaat ataattttaa aaaaacatag 26820
taaagtcaat gagatcctct ctgacctcag tgatcattta gtcatgtatg tacaacaatc 26880
attgttcatc acatgactgt aaaataaata aggataaact tgggaatata tataatatat 26940
tgtattaaat aaaaaaggga aatacaaata tcaattttag attcccgagt tgacacaact 27000
caccatgcac gctgccacct cagctcccag ctctcgtcac atgtctcatg tcagttaggt 27060
ctttggtttt tagtctttga cacaactcgc catgcatgtt gccacgtgag ctcgttcctc 27120
ttcccatgat ctcaccactg ggcatgcatg ctgccacctc agctggcacc tcttctctat 27180
atgtccctag aggccatgca cagtgccacc tcagcactcc tctcagaacc catacgtacc 27240
tgccaatcgg cttctctcca taaatatcta tttaaattat aactaattat ttcatatact 27300
taattgatga cgtggatgca ttgccatcgt tgtttaataa ttgttaatta cgacatgata 27360
aataaaatga aagtaaaaag tacgaaagat tttccatttg ttgttgtata aatagagaag 27420
tgagtgatgc ataatgcatg aatgcatgac cgcgccacca tgactgttgg atacgacgag 27480
gagatcccat tcgagcaagt tagggctcat aacaagccag acgacgcttg gtgtgctatt 27540
cacggacacg tgtacgacgt taccaagttc gcttcagttc acccaggagg agatattatc 27600
ttgctcgctg ctggaaagga agctactgtc ctctacgaga cctaccatgt tagaggagtg 27660
tctgacgctg tgctcagaaa gtacagaata ggaaagttgc cagacggaca aggaggagct 27720
aacgagaagg agaagagaac cttgtctgga ttgtcctctg cttcttacta cacctggaac 27780
tccgatttct acagagtgat gagggagaga gttgtggcta gattgaagga gagaggaaag 27840
gctagaagag gaggatacga actctggatc aaggctttct tgctccttgt tggattctgg 27900
tcctctcttt actggatgtg caccctcgat ccatctttcg gagctatctt ggctgctatg 27960
tctttgggag tgttcgctgc ttttgttgga acctgcatcc aacacgatgg aaaccacgga 28020
gctttcgctc aatctagatg ggttaacaag gtggcaggat ggactttgga tatgatcgga 28080
gcttctggaa tgacttggga gttccaacac gtgttgggac accacccata cactaacttg 28140
atcgaggagg agaacggatt gcaaaaggtg tccggaaaga agatggatac caagttggct 28200
gatcaagagt ctgatccaga tgtgttctcc acctacccaa tgatgagatt gcacccttgg 28260
caccagaaga ggtggtatca caggttccag cacatctacg gacctttcat cttcggattc 28320
atgaccatca acaaggtggt gactcaagat gttggagtgg tgttgagaaa gagactcttc 28380
caaatcgatg ctgagtgcag atatgcttcc ccaatgtacg ttgctaggtt ctggattatg 28440
aaggctttga ccgtgttgta tatggttgct ttgccttgtt atatgcaagg accttggcac 28500
ggattgaaac tcttcgctat cgctcacttc acttgcggag aggttttggc taccatgttc 28560
atcgtgaacc acattatcga gggagtgtct tacgcttcta aggatgctgt taagggaact 28620
atggctccac caaagactat gcacggagtg accccaatga acaacactag aaaggaggtt 28680
gaggctgagg cttctaagtc tggagctgtg gttaagtctg tgccattgga tgattgggct 28740
gctgttcagt gccaaacctc tgtgaactgg tctgttggat cttggttttg gaaccacttc 28800
tctggaggac tcaaccacca aatcgagcac cacctcttcc caggattgtc tcacgagacc 28860
tactaccaca tccaagacgt ggttcaatct acctgtgctg agtacggagt tccataccaa 28920
cacgagccat ctttgtggac tgcttactgg aagatgctcg aacaccttag acaattggga 28980
aacgaggaga ctcacgagtc atggcagaga gctgcttgat taatgaacta agactcccaa 29040
aaccaccttc cctgtgacag ttaaaccctg cttatacctt tcctcctaat aatgttcatc 29100
tgtcacacaa actaaaataa ataaaatggg agcaataaat aaaatgggag ctcatatatt 29160
tacaccattt acactgtcta ttattcacca tgccaattat tacttcataa ttttaaaatt 29220
atgtcatttt taaaaattgc ttaatgatgg aaaggattat tataagttaa aagtataaca 29280
tagataaact aaccacaaaa caaatcaata taaactaact tactctccca tctaattttt 29340
atttaaattt ctttacactt ctcttccatt tctatttcta caacattatt taacattttt 29400
attgtatttt tcttactttc taactctatt catttcaaaa atcaatatat gtttatcacc 29460
acctctctaa aaaaaacttt acaatcattg gtccagaaaa gttaaatcac gagatggtca 29520
ttttagcatt aaaacaacga ttcttgtatc actatttttc agcatgtagt ccattctctt 29580
caaacaaaga cagcggctat ataatcgttg tgttatattc agtctaaaac aactagctag 29640
cctcagctga cgttacgtaa cgctaggtag cgtcacgtga cgttagctaa cgctaggtag 29700
cgtcagctga gcttacgtaa gcgccacggg caggacatag ggactactac aagcatagta 29760
tgcttcagac aaagagctag gaaagaactc ttgatggagg ttaagagaaa aaagtgctag 29820
aggggcatag taatcaaact tgtcaaaacc gtcatcatga tgagggatga cataatataa 29880
aaagttgact aaggtcttgg tagtactctt tgattagtat tatatattgg tgagaacatg 29940
agtcaagagg agacaagaaa ccgaggaacc atagtttagc aacaagatgg aagttgcaaa 30000
gttgagctag ccgctcgatt agttacatct cctaagcagt actacaagga atggtctcta 30060
tactttcatg tttagcacat ggtagtgcgg attgacaagt tagaaacagt gcttaggaga 30120
caaagagtca gtaaaggtat tgaaagagtg aagttgatgc tcgacaggtc aggagaagtc 30180
cctccgccag atggtgacta ccaaggggtt ggtatcagct gagacccaaa taagattctt 30240
cggttgaacc agtggttcga ccgagactct tagggtggga tttcactgta agatttgtgc 30300
attttgttga atataaattg acaatttttt ttatttaatt atagattatt tagaatgaat 30360
tacatattta gtttctaaca aggatagcaa tggatgggta tgggtacagg ttaaacatat 30420
ctattaccca cccatctagt cgtcgggttt tacacgtacc cacccgttta cataaaccag 30480
accggaattt taaaccgtac ccgtccgtta gcgggtttca gatttacccg tttaatcggg 30540
taaaacctga ttactaaata tatatttttt atttgataaa caaaacaaaa atgttaatat 30600
tttcatattg gatgcaattt taagaaacac atattcataa atttccatat ttgtaggaaa 30660
ataaaaagaa aaatatattc aagaacacaa atttcaccga catgactttt attacagagt 30720
tggaattaga tctaacaatt gaaaaattaa aattaagata gaatatgttg aggaacatga 30780

catagtataa tgctgggtta cccgtcgggt aggtatcgag gcggatacta ctaaatccat 30840
cccactcgct atccgataat cactggtttc gggtataccc attcccgtca acaggccttt 30900
ttaaccggat aatttcaact tatagtgaat gaattttgaa taaatagtta gaataccaaa 30960
atcctggatt gcatttgcaa tcaaattttg tgaaccgtta aattttgcat gtacttggga 31020
tagatataat agaaccgaat tttcattagt ttaatttata acttactttg ttcaaagaaa 31080
aaaaatatct atccaattta cttataataa aaaataatct atccaagtta cttattataa 31140
tcaacttgta aaaaggtaag aatacaaatg tggtagcgta cgtgtgatta tatgtgacga 31200
aatgttatat ctaacaaaag tccaaattcc catggtaaaa aaaatcaaaa tgcatggcag 31260
gctgtttgta accttggaat aagatgttgg ccaattctgg agccgccacg tacgcaagac 31320
tcagggccac gttctcttca tgcaaggata gtagaacacc actccaccca cctcctatat 31380
tagacctttg cccaaccctc cccaactttc ccatcccatc cacaaagaaa ccgacatttt 31440
tatcataaat cagggtttcg tttttgtttc atcgataaac tcaaaggtga tgattttagg 31500
gtcttgtgag tgtgcttttt tgtttgattc tactgtaggg tttatgttct ttagctcata 31560
ggttttgtgt atttcttaga aatgtggctt ctttaatctc tgggtttgtg actttttgtg 31620
tggtttctgt gtttttcata tcaaaaacct attttttccg agtttttttt tacaaattct 31680
tactctcaag cttgaatact tcacatgcag tgttcttttg tagattttag agttaatgtg 31740
ttaaaaagtt tggatttttc ttgcttatag agcttcttca ctttgatttt gtgggttttt 31800
ttgttttaaa ggtgagattt ttgatgaggt ttttgcttca aagatgtcac ctttctgggt 31860
ttgtcttttg aataaagcta tgaactgtca catggctgac gcaattttgt tactatgtca 31920
tgaaagctga cgtttttccg tgttatacat gtttgcttac acttgcatgc gtcaaaaaaa 31980
ttggggcttt ttagttttag tcaaagattt tacttctctt ttgggattta tgaaggaaag 32040
ttgcaaactt tctcaaattt taccattttt gctttgatgt ttgtttagat tgcgacagaa 32100
caaactcata tatgttgaaa tttttgcttg gttttgtata ggattgtgtc ttttgcttat 32160
aaatgttgaa atctgaactt ttttttttgtt tggtttcttt gagcaggaga taaggcgcac 32220
caccatggct tctacatctg ctgctcaaga cgctgctcct tacgagttcc cttctctcac 32280
tgagatcaag agggctcttc cttctgagtg tttcgaggct tctgttcctc tttctctcta 32340
ctacaccgct agatctcttg ctcttgctgg atctctcgct gttgctctct cttacgctag 32400
agctttgcct cttgttcagg ctaacgctct tcttgatgct actctctgca ctggatacgt 32460
tcttctccag ggaatcgttt tctggggatt cttcaccgtt ggtcacgatt gtggacacgg 32520
agctttctct agatctcacg tgctcaactt ctctgttgga accctcatgc actctatcat 32580
ccttacccct ttcgagtctt ggaagctctc tcacagacac caccacaaga acaccggaaa 32640
catcgataag gacgagatct tctaccctca aagagaggct gattctcacc ctgtttctag 32700
acaccttgtg atgtctcttg gatctgcttg gttcgcttac cttttcgctg gattccctcc 32760
tagaaccatg aaccacttca acccttggga ggctatgtat gttagaagag tggctgctgt 32820
gatcatctct ctcggagttc ttttcgcttt cgctggactc tactcttacc tcaccttcgt 32880
tcttggattc accactatgg ctatctacta cttcggacct ctcttcatct tcgctaccat 32940
gcttgttgtt accactttcc tccaccacaa cgatgaggag acaccttggt acgctgattc 33000
tgagtggact tacgtgaagg gaaacctctc ttctgtggac agatcttacg gtgctctcat 33060
cgacaacctt agccacaaca tcggaactca ccagatccac cacctcttcc ctatcatccc 33120
tcactacaag ctcaacgatg ctactgctgc tttcgctaag gctttccctg agcttgttag 33180
gaaaaacgct gctcctatca tcccaacttt cttcaggatg gctgctatgt acgctaagta 33240
cggagttgtt gacactgatg ctaagacctt cactctcaag gaggctaagg ctgctgctaa 33300
gactaagtca tcttgatgat taatgaaggc cgcagatatc agatctggtc gacctagagg 33360
atccccggcc gcaaagataa taacaaaagc ctactatata acgtacatgc aagtattgta 33420
tgatattaat gtttttacgt acgtgtaaac aaaaataatt acgtttgtaa cgtatggtga 33480
tgatgtggtg cactaggtgt aggccttgta ttaataaaaa gaagtttgtt ctatatagag 33540
tggtttagta cgacgattta tttactagtc ggattggaat agagaaccga attcttcaat 33600
ccttgctttt gatcaagaat tgaaaccgaa tcaaatgtaa aagttgatat atttgaaaaa 33660
cgtattgagc ttatgaaaat gctaatactc tcatctgtat ggaaaagtga ctttaaaacc 33720
gaacttaaaa gtgacaaaag gggaatatcg catcaaaccg aatgaaaccg atctacgtag 33780
gctcagctga gcttacctaa ggctacgtag gctcacgtga cgttacgtaa ggctacgtag 33840
cgtcacgtga gcttacctaa ctctagctag cctcacgtga ccttagctaa cactaggtag 33900
cgtcagctta gcagatattt ggtgtctaaa tgtttatttt gtgatatgtt catgtttgaa 33960
atggtggttt cgaaaccagg gacaacgttg ggatctgata gggtgtcaaa gagtattatg 34020
gattgggaca atttcggtca tgagttgcaa attcaagtat atcgttcgat tatgaaaatt 34080
ttcgaagaat atcccatttg agagagtctt tacctcatta atgtttttag attatgaaat 34140
tttatcatag ttcatcgtag tctttttggt gtaaaggctg taaaaagaaa ttgttcactt 34200
ttgttttcgt ttatgtgaag gctgtaaaag attgtaaaag actattttgg tgttttggat 34260
aaaatgatag tttttataga ttcttttgct tttagaagaa atacatttga aatttttttcc 34320
atgttgagta taaaataccg aaatcgattg aagatcatag aaatatttta actgaaaaca 34380
aatttataac tgattcaatt ctctccattt ttatacctat ttaaccgtaa tcgattctaa 34440
tagatgatcg atttttttata taatcctaat taaccaacgg catgtattgg ataattaacc 34500
gatcaactct cacccctaat agaatcagta ttttccttcg acgttaattg atcctacact 34560
atgtaggtca tatccatcgt tttaattttt ggccaccatt caattctgtc ttgcctttag 34620
ggatgtgaat atgaacggcc aaggtaagag aataaaaata atccaaatta aagcaagaga 34680
ggccaagtaa gataatccaa atgtacactt gtcattgcca aaattagtaa aatactcggc 34740
atattgtatt cccacacatt attaaaatac cgtatatgta ttggctgcat ttgcatgaat 34800
aatactacgt gtaagcccaa aagaacccac gtgtagccca tgcaaagtta acactcacga 34860

ccccattcct cagtctccac tatataaacc caccatcccc aatctcacca aacccaccac 34920
acaactcaca actcactctc acaccttaaa gaaccaatca ccaccaaaaa aagttctttg 34980
ctttcgaagt tgccgcaacc taaacaggtt tttccttctt ctttcttctt attaactacg 35040
accttgtcct ttgcctatgt aaaattacta ggttttcatc agttacactg attaagttcg 35100
ttatagtgga agataaaatg ccctcaaagc attttgcagg atatctttga tttttcaaag 35160
atatggaact gtagagtttg atagtgttct tgaatgtggt tgcatgaagt ttttttggtc 35220
tgcatgttat tttttcctcg aaatatgttt tgagtccaac aagtgattca cttgggattc 35280
agaaagttgt tttctcaata tgtaacagtt tttttctatg gagaaaaatc atagggaccg 35340
ttggttttgg cttctttaat tttgagctca gattaaaccc attttacccg gtgttcttgg 35400
cagaattgaa aacagtacgt agtaccgcgc ctaccatgcc acctagtgct gctagtgaag 35460
gtggtgttgc tgaacttaga gctgctgaag ttgctagcta cactagaaag gctgttgacg 35520
aaagacctga cctcactata gttggtgacg ctgtttacga cgctaaggct tttagggacg 35580
agcaccctgg tggtgctcac ttcgttagcc ttttcggagg tagggacgct actgaggctt 35640
ttatggaata tcaccgtaga gcttggccta aggctaggat gtctaagttc ttcgttggtt 35700
cacttgacgc tagcgagaag cctactcaag ctgattcagc ttaccttaga ctttgcgctg 35760
aggttaacgc tcttttgcct aagggtagcg gaggattcgc tcctcctagc tactggctta 35820
aggctgctgc tcttgttgtt gctgctgtta gtatagaggg ttatatgctc cttaggggta 35880
agacccttt gcttagcgtt ttccttggac tcgtgttcgc ttggatagga cttaatattc 35940
agcacgacgc taatcacggt gctcttagta gacactcagt gattaactac tgcctcggtt 36000
acgctcagga ttggataggt ggtaatatgg tgctttggct tcaagagcac gttgtgatgc 36060
accacctcca cactaacgac gttgacgctg atcctgatca aaaggctcac ggtgttctta 36120
gacttaagcc tactgacggt tggatgcctt ggcacgcact tcaacaactc tatatccttc 36180
ctggtgaggc tatgtacgct tttaagcttc ttttcttgga cgcccttgag cttcttgctt 36240
ggaggtggga gggtgagaag attagccctc ttgctagagc tttgttcgct cctgctgttg 36300
cttgtaagct tggattctgg gctagattcg ttgctctccc tctctggctt caacctactg 36360
ttcacactgc tttgtgtatc tgtgctactg tgtgtactgg tagcttctac ctcgccttct 36420
tcttctttat ctctcacaac ttcgacggtg ttggtagcgt tggacctaag ggatcacttc 36480
ctagatcagc tactttcgtt caacgtcagg ttgagactag ctctaacgtt ggtggttact 36540
ggcttggagt tcttaacggt ggacttaact ttcagataga gcaccacttg ttccctaggc 36600
ttcaccactc ttactacgct caaatagctc ctgtggttag gactcacata gagaagctcg 36660
gttttaagta ccgtcacttc cctaccgttg gatctaacct tagctcaatg cttcagcata 36720
tgggtaagat gggaactaga cctggtgctg agaagggtgg taaggctgag tagtgattaa 36780
tgaataattg attgctgctt taatgagata tgcgagacgc ctatgatcgc atgatatttg 36840
ctttcaattc tgttgtgcac gttgtaaaaa acctgagcat gtgtagctca gatccttacc 36900
gccggtttcg gttcattcta atgaatatat cacccgttac tatcgtattt ttatgaataa 36960
tattctccgt tcaatttact gattgtctac gtagcgtcac ctgacgttac gtaaggctac 37020
ctaggctcac gtgacgttac gtaacgctac gtagcgtcag gtgaggttag ctaacgctag 37080
ctagcctcac ctgacgttag gtaaggctac gtagcgtcac ctgagattag ctaagcctac 37140
ctagactcac gtgaccttag gtaacgctac gtagcgtcaa agctttacaa cgctacacaa 37200
aacttataac cgtaatcacc attcattaac ttaactacta tcacatgcat tcatgaattg 37260
aaacgagaag gatgtaaata gttgggaagt tatctccacg ttgaagagat cgttagcgag 37320
agctgaaaga ccgagggagg agacgccgtc aacacggaca gagtcgtcga ccctcacatg 37380
aagtaggagg aatctccgtg aggagccaga gagacgtctt tggtcttcgg tttcgatcct 37440
tgatctgacg gagaagacga gagaagtgcg actggactcc gtgaggacca acagagtcgt 37500
cctcggtttc gatcgtcggt attggtggag aaggcggagg aatctccgtg acgagccaga 37560
gagatgtcgt cggtcttcgg tttcgatcct tgatctgacg gagaagacga gagaagtgcg 37620
acgagactcc gtgaggacca acagagttgt cctcggtttc gatcgtcggt ttcggcggag 37680
aaggcggagg aatctccgtg aggagccaga gagacgtcgt tggtcttcgg tttcgatcct 37740
tgatctgttg gagaagacga gacaagtggg acgagactca acgacggagt cagagacgtc 37800
gtcggtcttc ggtttcggcc gagaaggcgg agtcggtctt cggtttcggc cgagaaggcg 37860
gaggagacgt cttcgatttg ggtctctcct cttgacgaag aaaacaaaga acacgagaaa 37920
taatgagaaa gagaacaaaa gaaaaaaaaa taaaaataaa aataaaattt ggtcctctta 37980
tgtggtgaca cgtggtttga aacccaccaa ataatcgatc acaaaaaacc taagttaagg 38040
atcggtaata acctttctaa ttaattttga tttatattaa atcactcttt ttatttataa 38100
accccactaa attatgcgat attgattgtc taagtacaaa aattctctcg aattcaatac 38160
acatgtttca tatatttagc cctgttcatt taatattact agcgcatttt taatttaaaa 38220
ttttgtaaac ttttttggtc aaagaacatt tttttaatta gagacagaaa tctagactct 38280
ttatttggaa taatagtaat aaagatatat taggcaatga gtttatgatg ttatgtttat 38340
atagtttatt tcattttaaa ttgaaaagca ttattttttat cgaaatgaat ctagtataca 38400
atcaatattt atgttttttc atcagatact ttcctatttt ttggcacctt tcatcggact 38460
actgatttat ttcaatgtgt atgcatgcat gagcatgagt atacacatgt cttttaaaat 38520
gcatgtaaag cgtaacggac cacaaaagag gatccataca aatacatctc atcgcttcct 38580
ctactattct ccgacacaca cactgagcat ggtgcttaaa cactctggtg agttctagta 38640
cttctgctat gatgttaaat tttatattat atacctactt cctctctctc gctctgttat 38700
gttcgatttc gaaaggattt caagatcaaa gatgatgaga aaaggtacct tttcgatatt 38760
taagacaagg aaagaaagga cgaggttgaa attttcggga cttggagggc taaagtggaa 38820
gagactgaat ctgaagatgt cgtttctcga aactttgaga tacagaatca tgtctatcat 38880
tgaaggaatg gttttggttt ctaagcttgc tttcttcttt ctctgttgcg gttgcagatt 38940

ttaacacgtt agttttttt ttttcgtttt tttgaacgtc aacaatgtct tttttgtact 39000
ctttagctca tgtgtaaaat tctaaattct tccaataaca tacccaacaa attattcgta 39060
tctgattttt atagttttta acctgttaat gtaattaatc taagtgtaat ttttaggcta 39120
aatgttaaat tttatattaa agttttgtaa cttgaaatta cattcttctt atagcggata 39180
aacagaaaat gctcttaaac aaatcctgaa acaagtaaaa aatacaacag aaaaatctaa 39240
cgtttaattc ttaaaacctc aaaatcctta tttttacagc tttcaaagtt taacagctgg 39300
aaacctgtag aaaatcagac acagcctctc aagttttctg gacaataaat actggtaacg 39360
taagaaaacc aattaatgat accgtcgttc agtagataga actgacgatg tgaagattaa 39420
ttgtttctgt aatatactga atttgaaaat ttatcatcat catgttaacg gaagttgtct 39480
gtaaaagtag ttgattacct gttatcgtgt aaagtagtta gtaatttctt gcttatttga 39540
aaaatagaga acatttaaca tgtattttta aataggcacg accatgctac tgaactttat 39600
gaaatgcttt ggaatcttat 39620

<210> 308
<211> 37487
<212> DNA
<213> Artificial Sequence

<220>
<223> T-DNA insertion in LBFDAU Locus 2, including left and right border sequences

<400> 308
ttggggtgag agttgatcgg ttaattatcc aatacatgcc gttggttaat taggattata 60
taaaaaatcg atcatctatt agaatcgatt acggttaaat aggtataaaa atggagagaa 120
ttgaatcagt tataaatttg ttttcagtta aaatatttct atgatcttca atcgatttcg 180
gtattttata ctcaacatgg aaaaaatttc aaatgtattt cttctaaaag caaaagaatc 240
tataaaaact atcattttat ccaaaacacc aaaatagtct tttacaatct tttacagcct 300
tcacataaac gaaaacaaaa gtgaacaatt tctttttaca gcctttacac caaaaagact 360
acgatgaact atgataaaat ttcataatct aaaaacatta atgaggtaaa gactctctca 420
aatgggatat tcttcgaaaa ttttcataat cgaacgatat acttgaattt gcaactcatg 480
accgaaattg tcccaatcca taatactctt tgacacccta tcagatccca acgttgtccc 540
tggtttcgaa accaccattt caaacatgaa catatcacaa aataaacatt tagacaccaa 600
atatctgcta agcgcttacg taagctcagc tgacgctacc tagcgttagc taacgtcacg 660
tgacgctacc tagcgttacg taacgtcagc tgaggctagc tagctgaatt aacgccgaat 720
taattcgggg gatctggatt ttagtactgg attttggttt taggaattag aaattttatt 780
gatagaagta ttttacaaat acaaatacat actaagggtt tcttatatgc tcaacacatg 840
agcgaaaccc tataggaacc ctaattccct tatctgggaa ctactcacac attattatgg 900
agaaactcga gcttgtcgat cactcggtct tagctccctt ttgctttcca tcggatggct 960
tgatgtactt ttgcacgtag aagtttccga agaggaacaa gagggagatc atgtagtaga 1020
agaggatctt gatgagccat tgtggatatg gagcgttggt tttcatatcg tagtaagctt 1080
gcaccaagtt gagcatgaac tggaacatct ggaattgggt gaggtatctt ccccagaaga 1140
ggtacttgtt cttgagcttt ggggaagatc tcaagcaagc agccaagaag tagtaagcgt 1200
acatcaacac gtgcactcca gagttgagag cagcactcca ataagcctct cctcctggag 1260
cgtggtgagc aatagcccac cagataaggg agatagaaga gtggtggtac acgtggagga 1320
aagaaatctg tctggtggat ctcttgagga tcatgatcac ggtatccatg aactccacgt 1380
acttggacat gtagaagagg taaacgagga tagccatctc cttgtgcttt gggttataag 1440
cgtttcccca caaggaatat ctccaggtga tagcttggta agcgataccc acgcacatgt 1500
aaagagacaa agcgaagcag aacaagttgt gcaccaacac caaagcttgc aacaagaatg 1560
gctcagaagc tcttggcttg agatctctag ccttgatcca aagcaatcct ccgatcacga 1620
tggtcaagta aacagacact cccaacacaa ttggagttgg agaatcaacg agtggcaatc 1680
ccttagtagt tggggtatca gtcaactcaa ctccgaaaga tcccaacaaa gcgttcactc 1740
cttgggaaac ctttccatcc aactctccgt agaacctctc aacaacttcc atggtttctt 1800
ctaaagctga aagtgaacca ttattacaac ttaacactca actcacaaga ggagaagcaa 1860
caaagcttat gtaaggattt agtattaagg ccaaaaaaac acagatcaaa ttcaattatt 1920
gaagctttac ttatcaagtt atcatataac caatgaagac ggtaattcaa aagaaaaata 1980
aaagggtttg tagaataatt gatacgttta cctttgccga ttcagagaca gtgaagctta 2040
aacagtactg gctatgaaga aattataatc gtgtaaaact tagtgagtgt gtatgaatga 2100
aagtattgca aaatcctcat tatatagact acatgcataa ctagttgcat gtaaatttgt 2160
agttttcttc attattgcat cctccaagtg gatgtcatgg ttttacacat ggcttccatg 2220
caaatcattt ccaaaatatt tttaaacttt ccacagggca tccatgcatg cacctcaaaa 2280
cttgtgtgtg gtaacattgt tgtcttgaaa aattactaaa ccttttgtcc acgtgacgtt 2340
catgcacctc aaatcttgtg tggtaccatt attatcctca agaattattg aatgtttggt 2400
gtatatgcca tccatgcagc attgcaacaa ttaaatctcc aaaccttgtg gtaccatatt 2460
cactcacttt aattctccta tagtagaaat attagcaaat atttacattt ccagttgatt 2520
agtatatgta tttagaagac aaaaataatt tagaatcaat taatcaactt gcaaattgct 2580
aagtgttggc aaacgttagc ataaaaggtg ttataaattt agtaccaaat ataaaaattt 2640
atcgcaaatc aaatacataa cacacatagt aaaacaaaaa caaattacaa gggtttagac 2700

gtttagtggc aatgtgtaaa tttgctgcag gagtgacgct agctagcgtt acgtaacgtc 2760
agctgagcct aggtagcgtt agctaagctc acgtgacgct acgtaggctt acgtaacgtc 2820
agctgaggct acgtagcgtt agctaacgtc acgtgacgct acgtaggctt acgtaatagt 2880
tactaatcag tgatcaggcg cgccattaat ttccaccttc acctacgatg gggggcatcg 2940
caccggtgag taatattgta cggctaagag cgaatttggc ctgtagacct caattgcgag 3000
ctttctaatt tcaaactatt cgggcctaac ttttggtgtg atgatgctga ctgtttcgac 3060
gttaattgat cctacactat gtaggtcata tccatcgttt taatttttgg ccaccattca 3120
attctgtctt gcctttaggg atgtgaatat gaacggccaa ggtaagagaa taaaaataat 3180
ccaaattaaa gcaagagagg ccaagtaaga taatccaaat gtacacttgt cattgccaaa 3240
attagtaaaa tactcggcat attgtattcc cacacattat taaaataccg tatatgtatt 3300
ggctgcattt gcatgaataa tactacgtgt aagcccaaaa gaacccacgt gtagcccatg 3360
caaagttaac actcacgacc ccattcctca gtctccacta tataaaccca ccatccccaa 3420
tctcaccaaa cccaccacac aactcacaac tcactctcac accttaaaga accaatcacc 3480
accaaaaaat ttcacgattt ggaatttgat tcctgcgatc acaggtatga caggttagat 3540
tttgttttgt atagttgtat acatacttct ttgtgatgtt ttgtttactt aatcgaattt 3600
ttggagtgtt ttaaggtctc tcgtttagaa atcgtggaaa atatcactgt gtgtgtgttc 3660
ttatgattca cagtgtttat gggtttcatg ttctttgttt tatcattgaa tgggaagaaa 3720
tttcgttggg atacaaattt ctcatgttct tactgatcgt tattaggagt ttggggaaaa 3780
aggaagagtt tttttggttg gttcgagtga ttatgaggtt atttctgtat ttgatttatg 3840
agttaatggt cgttttaatg ttgtagacat gggaaaagga tctgagggaa gatctgctgc 3900
tagagagatg actgctgagg ctaacggaga taagagaaag accatcctca ttgagggagt 3960
gttgtacgat gctaccaact tcaaacaccc aggaggttcc attattaact tcctcaccga 4020
gggagaagct ggagttgatg ctacccaagc ttacagagag ttccatcaga gatccggaaa 4080
ggctgataag tacctcaagt ccctcccaaa gttggatgct tctaaggtgg agtctaggtt 4140
ctctgctaag gagcaggcta gaagggacgc tatgaccagg gattacgctg ctttcagaga 4200
ggagttggtt gctgagggat acttcgatcc atctatccca cacatgatct acagagtggt 4260
ggagattgtg gctttgttcg ctttgtcttt ctggttgatg tctaaggctt ctccaacctc 4320
tttggttttg ggagtggtga tgaacggaat cgctcaagga agatgcggat gggttatgca 4380
cgagatggga cacggatctt tcactggagt tatctggctc gatgatagga tgtgcgagtt 4440
cttctacgga gttggatgtg gaatgtctgg acactactgg aagaaccagc actctaagca 4500
ccacgctgct ccaaacagat tggagcacga tgtggatttg aacaccttgc cactcgttgc 4560
tttcaacgag agagttgtga ggaaggttaa gccaggatct ttgttggctt tgtggctcag 4620
agttcaggct tatttgttcg ctccagtgtc ttgcttgttg atcggattgg gatggacctt 4680
gtacttgcac ccaagatata tgctcaggac caagagacac atggagtttg tgtggatctt 4740
cgctagatat atcggatggt tctccttgat gggagctttg ggatattctc ctggaacttc 4800
tgtgggaatg tacctctgct ctttcggact tggatgcatc tacatcttcc tccaattcgc 4860
tgtgtctcac acccacttgc cagttaccaa cccagaggat caattgcact ggcttgagta 4920
cgctgctgat cacaccgtga acatctctac caagtcttgg ttggttacct ggtggatgtc 4980
taacctcaac ttccaaatcg agcaccactt gttcccaacc gctccacaat tcaggttcaa 5040
ggagatctct ccaagagttg aggctctctt caagagacac aacctccctt actacgattt 5100
gccatacacc tctgctgttt ctactacctt cgctaacctc tactctgttg gacactctgt 5160
tggagctgat accaagaagc aggattgact gctttaatga gatatgcgag acgcctatga 5220
tcgcatgata tttgctttca attctgttgt gcacgttgta aaaaacctga gcatgtgtag 5280
ctcagatcct taccgccggt ttcggttcat tctaatgaat atatcacccg ttactatcgt 5340
atttttatga ataatattct ccgttcaatt tactgattgt ctacgtaggc tcagctgagc 5400
ttacctaagg ctacgtaggc tcacgtgacg ttacgtaagg ctacgtagcg tcacgtgagc 5460
ttacctaact ctagctagcc tcacgtgacc ttagctaaca ctaggtagcg tcagctcgac 5520
ggcccggact gtatccaact tctgatcttt gaatctctct gttccaacat gttctgaagg 5580
agttctaaga cttttcagaa agcttgtaac atgctttgta gactttcttt gaattactct 5640
tgcaaactct gattgaacct acgtgaaaac tgctccagaa gttctaacca aattccgtct 5700
tgggaaggcc caaaatttat tgagtacttc agtttcatgg acgtgtcttc aaagatttat 5760
aacttgaaat cccatcattt ttaagagaag ttctgttccg caatgtctta gatctcattg 5820
aaatctacaa ctcttgtgtc agaagttctt ccagaatcaa cttgcatcat ggtgaaaatc 5880
tggccagaag ttctgaactt gtcatatttc ttaacagtta gaaaaatttc taagtgttta 5940
gaattttgac ttttccaaag caaacttgac ttttgacttt cttaataaaa caaacttcat 6000
attctaacat gtcttgatga aatgtgattc ttgaaatttg atgttgatgc aaaagtcaaa 6060
gtttgacttt tcagtgtgca attgaccatt ttgctcttgt gccaattcca aacctaaatt 6120
gatgtatcag tgctgcaaac ttgatgtcat ggaagatctt atgagaaaat tcttgaagac 6180
tgagaggaaa aattttgtag tacaacacaa agaatcctgt ttttcatagt cggactagac 6240
acattaacat aaaacaccac ttcattcgaa gagtgattga agaaggaaat gtgcagttac 6300
ctttctgcag ttcataagag caacttacag acacttttac taaaatacta caaagaggaa 6360
gattttaaca acttagagaa gtaatgggag ttaaagagca acacattaag gggagtgtt 6420
aaaattaatg tgttgtaacc accactacct ttagtaagta ttataagaaa attgtaatca 6480
tcacattata attattgtcc ttatttaaaa ttatgataaa gttgtatcat taagattgag 6540
aaaaccaaat agtcctcgtc ttgatttttg aattattgtt ttctatgtta cttttcttca 6600
agcctatata aaaactttgt aatgctaaat tgtatgctgg aaaaaaatgt gtaatgaatt 6660
gaatagaaat tatggtattt caaagtccaa aatccatcaa tagaaattta gtacaaaacg 6720
taactcaaaa atattctctt attttaaatt ttacaacaat ataaaaatat tctcttattt 6780

```
taaattttac aataatataa tttatcacct gtcaccttta gaataccacc aacaatatta   6840
atacttagat attttattct taataatttt gagatctctc aatatatctg atatttattt   6900
tatatttgtg tcatattttc ttatgtttta gagttaaccc ttatatcttg gtcaaactag   6960
taattcaata tatgagtttg tgaaggacac attgacatct tgaaacattg gttttaacct   7020
tgttggaatg ttaaaggtaa taaaacattc agaattatga ccatctatta atatacttcc   7080
tttgtctttt aaaaaagtgt gcatgaaaat gctctatggt aagctagagt gtcttgctgg   7140
cctgtgtata tcaattccat ttccagatgg tagaaactgc cactacgaat aattagtcat   7200
aagacacgta tgttaacaca cgtccccttg catgtttttt gccatatatt ccgtctcttt   7260
ctttttcttc acgtataaaa caatgaacta attaatagag cgatcaagct gaacagttct   7320
ttgctttcga agttgccgca acctaaacag gtttttcctt cttctttctt cttattaact   7380
acgaccttgt cctttgccta tgtaaaatta ctaggttttc atcagttaca ctgattaagt   7440
tcgttatagt ggaagataaa atgccctcaa agcattttgc aggatatctt tgatttttca   7500
aagatatgga actgtagagt ttgatagtgt tcttgaatgt ggttgcatga agttttttg   7560
gtctgcatgt tattttttcc tcgaaatatg ttttgagtcc aacaagtgat tcacttggga   7620
ttcagaaagt tgttttctca atatgtaaca gttttttct atggagaaaa atcataggga   7680
ccgttggttt tggcttcttt aattttgagc tcagattaaa cccattttac ccggtgttct   7740
tggcagaatt gaaaacagta cgtagtaccg cgcctaccat gtgtgttgag accgagaaca   7800
acgatggaat ccctactgtg gagatcgctt tcgatggaga gagagaaaga gctgaggcta   7860
acgtgaagtt gtctgctgag aagatggaac ctgctgcttt ggctaagacc ttcgctagaa   7920
gatacgtggt tatcgaggga gttgagtacg atgtgaccga tttcaaacat cctggaggaa   7980
ccgtgatttt ctacgctctc tctaacactg gagctgatgc tactgaggct ttcaaggagt   8040
tccaccacag atctagaaag gctaggaagg ctttggctgc tttgccttct agacctgcta   8100
agaccgctaa agtggatgat gctgagatgc tccaggattt cgctaagtgg agaaaggagt   8160
tggagaggga cggattcttc aagccttctc ctgctcatgt tgcttacaga ttcgctgagt   8220
tggctgctat gtacgctttg ggaacctact tgatgtacgc tagatacgtt gtgtcctctg   8280
tgttggttta cgcttgcttc ttcggagcta gatgtggatg ggttcaacac gagggaggac   8340
actcttcttt gaccggaaac atctggtggg ataagagaat ccaagctttc actgctggat   8400
tcggattggc tggatctgga gatatgtgga actccatgca caacaagcac cacgctactc   8460
ctcaaaaagt gaggcacgat atggatttgg ataccactcc tgctgttgct ttcttcaaca   8520
ccgctgtgga ggataataga cctaggggat tctctaagta ctggctcaga ttgcaagctt   8580
ggaccttcat tcctgtgact tctggattgg tgttgctctt ctggatgttc ttcctccacc   8640
cttctaaggc tttgaaggga ggaaagtacg aggagcttgt gtggatgttg gctgctcacg   8700
tgattagaac ctggaccatt aaggctgtta ctggattcac cgctatgcaa tcctacggac   8760
tcttcttggc tacttcttgg gtttccggat gctacttgtt cgctcacttc tctacttctc   8820
acacccactt ggatgttgtt cctgctgatg agcacttgtc ttgggttagg tacgctgtgg   8880
atcacaccat tgatatcgat ccttctcagg gatgggttaa ctggttgatg ggatacttga   8940
actgccaagt gattcaccac ctcttccctt ctatgcctca attcagacaa cctgaggtgt   9000
ccagaagatt cgttgctttc gctaagaagt ggaacctcaa ctacaaggtg atgacttatg   9060
ctggagcttg gaaggctact ttgggaaacc tcgataatgt gggaaagcac tactacgtgc   9120
acggacaaca ctctggaaag accgcttgat taatgaaggc cgcctcgacc gtacccctg   9180
cagatagact atactatgtt ttagcctgcc tgctggctag ctactatgtt atgttatgtt   9240
gtaaaataaa cacctgctaa ggtatatcta tctatatttt agcatggctt tctcaataaa   9300
ttgtctttcc ttatcgttta ctatcttata cctaataatg aaataataat atcacatatg   9360
aggaacgggg caggtttagg catatatata cgagtgtagg gcggagtggg gctacgtagc   9420
gtcacgtgac gttacctaag cctaggtagc ctcagctgac gttacgtaac gctaggtagg   9480
ctcagctgac acgggcagga catagggact actacaagca tagtatgctt cagacaaaga   9540
gctaggaaag aactcttgat ggaggttaag agaaaaaagt gctagagggg catagtaatc   9600
aaacttgtca aaaccgtcat catgatgagg gatgacataa tataaaaagt tgactaaggt   9660
cttggtagta ctctttgatt agtattatat attggtgaga acatgagtca agaggagaca   9720
agaaaccgag gaaccatagt ttagcaacaa gatggaagtt gcaaagttga gctagccgct   9780
cgattagtta catctcctaa gcagtactac aaggaatggt ctctatactt tcatgtttag   9840
cacatggtag tgcggattga caagttagaa acagtgctta ggagacaaag agtcagtaaa   9900
ggtattgaaa gagtgaagtt gatgctcgac aggtcaggag aagtccctcc gccagatggt   9960
gactaccaag ggttggtat cagctgagac ccaaataaga ttcttcggtt gaaccagtgg  10020
ttcgaccgag actcttaggg tgggatttca ctgtaagatt tgtgcatttt gttgaatata  10080
aattgacaat ttttttatt taattataga ttatttagaa tgaattacat atttagtttc  10140
taacaaggat agcaatggat gggtatgggt acaggttaaa catatctatt acccacccat  10200
ctagtcgtcg ggttttacac gtacccaccc gtttacataa accagaccgg aattttaaac  10260
cgtacccgtc cgttagcggg tttcagattt acccgtttaa tcgggtaaaa cctgattact  10320
aaatatatat tttttatttg ataaacaaaa caaaaatgtt aatattttca tattggatgc  10380
aattttaaga aacacatatt cataaatttc catatttgta ggaaaataaa aagaaaaata  10440
tattcaagaa cacaaatttc accgacatga cttttattac agagttggaa ttagatctaa  10500
caattgaaaa attaaaatta agatagaata tgttgaggaa catgacatag tataatgctg  10560
ggttacccgt cgggtaggta tcgaggcgga tactactaaa tccatcccac tcgctatccg  10620
ataatcactg gtttcgggta tacccattcc cgtcaacagg cctttttaac cggataattt  10680
caacttatag tgaatgaatt ttgaataaat agttagaata ccaaaatcct ggattgcatt  10740
tgcaatcaaa ttttgtgaac cgttaaattt tgcatgtact tgggatagat ataatagaac  10800
cgaattttca ttagtttaat ttataactta ctttgttcaa agaaaaaaaa tatctatcca  10860
```

```
atttacttat aataaaaaat aatctatcca agttacttat tataatcaac ttgtaaaaag  10920
gtaagaatac aaatgtggta gcgtacgtgt gattatatgt gacgaaatgt tatatctaac  10980
aaaagtccaa attcccatgg taaaaaaaat caaaatgcat ggcaggctgt ttgtaacctt  11040
ggaataagat gttggccaat tctggagccg ccacgtacgc aagactcagg gccacgttct  11100
cttcatgcaa ggatagtaga acaccactcc acccacctcc tatattagac ctttgcccaa  11160
ccctccccaa ctttcccatc ccatccacaa agaaaccgac atttttatca taaatctggt  11220
gcttaaacac tctggtgagt tctagtactt ctgctatgat cgatctcatt accatttctt  11280
aaatttctct ccctaaatat tccgagttct tgatttttga taacttcagg ttttctcttt  11340
ttgataaatc tggtctttcc attttttttt tttgtggtta atttagtttc ctatgttctt  11400
cgattgtatt atgcatgatc tgtgtttgga ttctgttaga ttatgtattg gtgaatatgt  11460
atgtgttttt gcatgtctgg ttttggtctt aaaaatgttc aaatctgatg atttgattga  11520
agcttttta gtgttggttt gattcttctc aaaactactg ttaatttact atcatgtttt  11580
ccaactttga ttcatgatga cacttttgtt ctgctttgtt ataaaatttt ggttggtttg  11640
attttgtaat tatagtgtaa ttttgttagg aatgaacatg ttttaatact ctgttttcga  11700
tttgtcacac attcgaatta ttaatcgata atttaactga aaattcatgg ttctagatct  11760
tgttgtcatc agattatttg tttcgataat tcatcaaata tgtagtcctt ttgctgattt  11820
gcgactgttt cattttttct caaaattgtt ttttgttaag tttatctaac agttatcgtt  11880
gtcaaaagtc tctttcattt tgcaaaatct tctttttttt tttgtttgta actttgtttt  11940
ttaagctaca catttagtct gtaaaatagc atcgaggaac agttgtctta gtagacttgc  12000
atgttcttgt aacttctatt tgtttcagtt tgttgatgac tgctttgatt ttgtaggtca  12060
aaggcgcacc ctaccatgga tgcttataac gctgctatgg ataagattgg agctgctatc  12120
atcgattgga gtgatccaga tggaaagttc agagctgata gggaggattg gtggttgtgc  12180
gatttcagat ccgctatcac cattgctctc atctacatcg ctttcgtgat cttgggatct  12240
gctgtgatgc aatctctccc agctatggac ccataccctа tcaagttcct ctacaacgtg  12300
tctcaaatct tcctctgcgc ttacatgact gttgaggctg gattcctcgc ttataggaac  12360
ggatacaccg ttatgccatg caaccacttc aacgtgaacg atccaccagt tgctaacttg  12420
ctctggctct tctacatctc caaagtgtgg gatttctggg ataccatctt cattgtgctc  12480
ggaaagaagt ggagacaact ctctttcttg cacgtgtacc accacaccac catcttcctc  12540
ttctactggt tgaacgctaa cgtgctctac gatggagata tcttcttgac catcctcctc  12600
aacggattca ttcacaccgt gatgtacacc tactacttca tctgcatgca caccaaggat  12660
tctaagaccg gaaagtcttt gccaatctgg tggaagtcat ctttgaccgc tttccaactc  12720
ttgcaattca ccatcatgat gtcccaagct acctacttgg ttttccacgg atgcgataag  12780
gtttccctca gaatcaccat cgtgtacttc gtgtacattc tctccctttt cttcctcttc  12840
gctcagttct tcgtgcaatc ctacatggct ccaaagaaga agaagtccgc ttgatgttaa  12900
tgaaggccgc agatatcaga tctggtcgac ctagaggatc cccggccgca aagataataa  12960
caaaagccta ctatataacg tacatgcaag tattgtatga tattaatgtt tttacgtacg  13020
tgtaaacaaa aataattacg tttgtaacgt atggtgatga tgtggtgcac taggtgtagg  13080
ccttgtatta ataaaaagaa gtttgttcta tatagagtgg tttagtacga cgatttattt  13140
actagtcgga ttggaataga gaaccgaatt cttcaatcct tgcttttgat caagaattga  13200
aaccgaatca aatgtaaaag ttgatatatt tgaaaaacgt attgagctta tgaaaatgct  13260
aatactctca tctgtatgga aaagtgactt taaaaccgaa cttaaaagtg acaaaagggg  13320
aatatcgcat caaaccgaat gaaaccgatc tacgtaggct cagctgagct tagctaagcc  13380
tacctagcct cacgtgagat tatgtaaggc taggtagcgt cacgtgacgt tacctaacac  13440
tagctagcgt cagctgagct tagctaaccc tacgtagcct cacgtgagct tacctaacgc  13500
tacgtagcct cacgtgacta aggatgacct acccattctt gagacaaatg ttacatttta  13560
gtatcagagt aaaatgtgta cctataactc aaattcgatt gacatgtatc cattcaacat  13620
aaaattaaac cagcctgcac ctgcatccac atttcaagta ttttcaaacc gttcggctcc  13680
tatccaccgg gtgtaacaag acggattccg aatttggaag attttgactc aaattcccaa  13740
tttatattga ccgtgactaa atcaacttta acttctataa ttctgattaa gctcccaatt  13800
tatattccca acggcactac ctccaaaatt tatagactct catccccttt taaaccaact  13860
tagtaaacgt ttttttttta attttatgaa gttaagtttt taccttgttt ttaaaaagaa  13920
tcgttcataa gatgccatgc cagaacatta gctacacgtt acacatagca tgcagccgcg  13980
gagaattgtt tttcttcgcc acttgtcact cccttcaaac acctaagagc ttctctctca  14040
cagcacacac atacaatcac atgcgtgcat gcattattac acgtgatcgc catgcaaatc  14100
tcctttatag cctataaatt aactcatcgg cttcactctt tactcaaacc aaaactcatc  14160
aatacaaaca agattaaaaa catttcacga tttggaattt gattcctgcg atcacaggta  14220
tgacaggtta gattttgttt tgtatagttg tatacatact tctttgtgat gttttgttta  14280
cttaatcgaa tttttggagt gttttaaggt ctctcgttta gaaatcgtgg aaaatatcac  14340
tgtgtgtgtg ttcttatgat tcacagtgtt tatgggtttc atgttctttg ttttatcatt  14400
gaatgggaag aaatttcgtt gggatacaaa tttctcatgt tcttactgat cgttattagg  14460
agtttgggga aaaaggaaga gttttttttgg ttggttcgag tgattatgag gttatttctg  14520
tatttgattt atgagttaat ggtcgtttta atgttgtaga ccgccatggc tattttgaac  14580
cctgaggctg attctgctgc taacctcgct actgattctg aggctaagca aagacaattg  14640
gctgaggctg gatacactca cgttgagggt gctcctgctc ctttgccttt ggagttgcct  14700
cacttctctc tcagagatct cagagctgct attcctaagc actgcttcga gagatctttc  14760
gtgacctcca cctactacat gatcaagaac gtgttgactt gcgctgcttt gttctacgct  14820
gctaccttca ttgatagagc tggagctgct gcttatgttt tgtggcctgt gtactggttc  14880
ttccagggat cttacttgac tggagtgtgg gttatcgctc acgagtgtgg acaccaggct  14940
```

tattgctctt ctgaggtggt gaacaacttg attggactcg tgttgcactc tgctttgttg 15000
gtgccttacc actcttggag aatctctcac agaaagcacc actccaacac tggatcttgc 15060
gagaacgatg aggttttcgt tcctgtgacc agatctgtgt tggcttcttc ttggaacgag 15120
accttggagg attctcctct ctaccaactc taccgtatcg tgtacatgtt ggttgttgga 15180
tggatgcctg gatacctctt cttcaacgct actggaccta ctaagtactg ggaaagtct 15240
aggtctcact tcaaccctta ctccgctatc tatgctgata gggagaggtg gatgatcgtg 15300
ctctccgata ttttcttggt ggctatgttg gctgttttgg ctgctttggt gcacactttc 15360
tccttcaaca cgatggtgaa gttctacgtg gtgccttact tcattgtgaa cgcttacttg 15420
gtgttgatta cctacctcca acacaccgat acctacatcc ctcacttcag agagggagag 15480
tggaattggt tgagaggagc tttgtgcact gtggatagat catttggtcc attcctcgat 15540
tctgtggtgc atagaatcgt ggatacccac gtttgccacc atatcttctc caagatgcct 15600
ttctatcact gcgaggaggc taccaacgct attaagcctc tcctcggaaa gttctacttg 15660
aaggatacta ctcctgttcc tgttgctctc tggagatctt acacccactg caagttcgtt 15720
gaggatgatg gaaaggtggt gttctacaag aacaagttat agttaatgaa taattgattg 15780
gttcgagtat tatggcattg ggaaaactgt tttcttgta ccatttgttg tgcttgtaat 15840
ttactgtgtt ttttattcgg ttttcgctat cgaactgtga aatggaaatg gatggagaag 15900
agttaatgaa tgatatggtc cttttgttca ttctcaaatt aatattattt gtttttctc 15960
ttatttgttg tgtgttgaat ttgaaattat aagagatatg caaacatttt gttttgagta 16020
aaaatgtgtc aaatcgtggc ctctaatgac cgaagttaat atgaggagta aaacacttgt 16080
agttgtacca ttatgcttat tcactaggca acaaatatat tttcagacct agaaaagctg 16140
caaatgttac tgaatacaag tatgtcctct tgtgttttag acatttatga actttccttt 16200
atgtaatttt ccagaatcct tgtcagattc taatcattgc tttataatta tagttatact 16260
catggatttg tagttgagta tgaaaatatt ttttaatgca ttttatgact tgccaattga 16320
ttgacaacat gcatcaatct agctagcctc agctgacgtt acgtaacgct aggtagcgtc 16380
acgtgacgtt agctaacgct aggtagcgtc agctgagctt acgtaagcgc acagatgaat 16440
actagctgtt gttcacagtt ctagtgtctc ctcattacgt gaattcaagc tacgatcact 16500
atctcaactc ctacataaac atcagaatgc tacaaaacta tgcacaaaaa caaaagctac 16560
atctaatacg tgaatcaatt actctcatca caagaaagaa gatttcaatc accgtcgaga 16620
aggaggattc agttaattga atcaaagttc cgatcaaact cgaagactgg tgagcacgag 16680
gacgacgaag aagagtgtct cgaagataca acaagcaaga aatctactga gtgacctcct 16740
gaagttattg gcgcgattga gagaatcaat ccgaattaat ttcggggaaa aagataaatt 16800
agatactaag cgatgggctt gggctgggct aagaaacagg tggcaattgg gctggaggac 16860
cccgcgattc atagcttccg atagcccaaa aaaaaacgga taacatattt atcgggtatt 16920
tgaatttcag tgaaataaga tattttcttt ttgttaggaa aattttagaa aataatggaa 16980
attaaatagc gattatgtta caagatacga tcagcatcgg gcagtgcaaa atgctatagc 17040
ttcccaagat ttgatccttt tgggttatct cctaatgaca attagtttag gattttgaaa 17100
cttatattaa tactattatc cgacaacact tgtttcagct tcttatttta acattttttg 17160
ttttttttcta ttcttcttcc catcagcatt ttctttttaa aaaattgaat actttaactt 17220
tttaaaaatt tcacaatgat cagatgatat tatggaagat ctcaagagtt aaatgtatcc 17280
atcttggggc attaaaaccg gtgtacggga tgataaatac agactttata tcatatgata 17340
gctcagtaat tcatatttat cacgttgcta aaaaaattat aaggtactag tagtcaacaa 17400
aatcaattaa agagaaagaa agaaacgcat gtgaagagag tttacaactg gaaaagtaaa 17460
ataaaaatta acgcatgttg aatgctgaca tgtcagtatg tccatgaatc cacgtatcaa 17520
gcgccattca tcgatcgtct tcctctttct aaatgaaaac aacttcacac atcacaacaa 17580
acaatacaca caagaccccc tctctctcgt tgtctctctg ccagcgacca aatcgaagct 17640
tgagaagaac aagaaggggt caaaccatgg cttctacatc tgctgctcaa gacgctgctc 17700
cttacgagtt cccttctctc actgagatca agagggctct tccttctgag tgtttcgagg 17760
cttctgttcc tctttctctc tactacaccg ctagatctct tgctcttgct ggatctctcg 17820
ctgttgctct ctcttacgct agagctttgc ctcttgttca ggctaacgct cttcttgatg 17880
ctactctctg cactggatac gttcttctcc agggaatcgt tttctgggga ttcttcaccg 17940
ttggtcacga ttgtggacac ggagctttct ctagatctca cgtgctcaac ttctctgttg 18000
gaaccctcat gcactctatc atccttaccc ctttcgagtc ttggaagctc tctcacagac 18060
accaccacaa gaacaccgga aacatcgata aggacgagat cttctaccct caaagagagg 18120
ctgattctca ccctgtttct agacaccttg tgatgtctct tggatctgct tggttcgctt 18180
accttttcgc tggattccct cctagaacca tgaaccactt caacccttgg gaggctatgt 18240
atgttagaag agtggctgct gtgatcatct ctctcggagt tcttttcgct ttcgctggac 18300
tctactctta cctcaccttc gttcttggat tcaccactat ggctatctac tacttcggac 18360
ctctcttcat cttcgctacc atgcttgttg ttaccacttt cctccaccac aacgatgagg 18420
agacaccttg gtacgctgat tctgagtgga cttacgtgaa gggaaacctc tcttctgtgg 18480
acagatctta cggtgctctc atcgacaacc ttagccacaa catcggaact caccagatcc 18540
accacctctt ccctatcatc cctcactaca agctcaacga tgctactgct gctttcgcta 18600
aggctttccc tgagcttgtt aggaaaaacg ctgctcctat catcccaact ttcttcagga 18660
tggctgctat gtacgctaag tacggagttg ttgacactga tgctaagacc ttcactctca 18720
aggaggctaa ggctgctgct aagactaagt catcttgatg attaatgaat aattgattgt 18780
acatactata ttttttgttt accttgtgtt agtttaatgt tcagtgtcct ctctttattg 18840
tggcacgtct ctttgttgta tgttgtgtct atacaaagtt gaaataatgg aaagaaaagg 18900
aagagtgtaa tttgttttgt tttaagtgtt tataaatata tatatatagg tcatttagat 18960
agttctaggt ttctataaaa ctctctctct ggaagtagaa tctgtttttg agaggatcca 19020

gttgcctact aatctccccc aaaacccttc aagcttaacc ttcctcttca caacaacaga 19080
ggaaacacat ctcttgagct ctgagttctc ttctttgagc atgtctatcg ctaaactcat 19140
ctgccttata gcttccctct tctcttcatc tctctctctc accatttcgc tgtaaaactt 19200
attctcctcc ctcagcctct ctatctcttc cttcagcatc tcacaattcc caccataatc 19260
gactgaggat gattcaccgt catcaacttc agactcagcg ttgtagtcgt catgagtctc 19320
acaagccttg gaccaagaag actcatcatc gcaagttgat gatttatcat gatgcttctc 19380
tgagccgtgt ttgctacgta gcgtcacgtg acgttaccta agcctaggta gcctcagctg 19440
acgttacgta acgctaggta ggctcagctg actgcagcaa atttacacat tgccactaaa 19500
cgtctaaacc cttgtaattt gtttttgttt tactatgtgt gttatgtatt tgatttgcga 19560
taaattttta tatttggtac taaatttata acacctttta tgctaacgtt tgccaacact 19620
tagcaatttg caagttgatt aattgattct aaattatttt tgtcttctaa atacatatac 19680
taatcaactg gaaatgtaaa tatttgctaa tatttctact ataggagaat taaagtgagt 19740
gaatatggta ccacaaggtt tggagattta attgttgcaa tgctgcatgg atggcatata 19800
caccaaacat tcaataattc ttgaggataa taatggtacc acacaagatt tgaggtgcat 19860
gaacgtcacg tggacaaaag gtttagtaat ttttcaagac aacaatgtta ccacacacaa 19920
gttttgaggt gcatgcatgg atgccctgtg gaaagtttaa aaatattttg gaaatgattt 19980
gcatggaagc catgtgtaaa accatgacat ccacttggag gatgcaataa tgaagaaaac 20040
tacaaattta catgcaacta gttatgcatg tagtctatat aatgaggatt ttgcaatact 20100
ttcattcata cacactcact aagttttaca cgattataat ttcttcatag ccagtactgt 20160
ttaagcttca ctgtctctga atcggcaaag gtaaacgtat caattattct acaaaccctt 20220
ttatttttct tttgaattac cgtcttcatt ggttatatga taacttgata agtaaagctt 20280
caataattga atttgatctg tgttttttttg gccttaatac taaatcctta cataagcttt 20340
gttgcttctc ctcttgtgag ttgagtgtta agttgtaata atggttcact ttcagcttta 20400
gaagaaacgc gccttccatg gctacaaagg aggcttacgt tttcccaact ctcaccgaga 20460
tcaagagatc tctcccaaag gattgcttcg aggcttctgt gcctttgtct ctctactaca 20520
ctgtgagatg cttggttatt gctgtggctt tgaccttcgg attgaactac gctagagctt 20580
tgccagaggt tgagtctttc tgggctttgg atgctgcttt gtgcactgga tatatcctcc 20640
tccagggaat tgtgttctgg ggattcttca ctgttggaca cgatgctgga cacggagctt 20700
tctctagata ccacctcttg aacttcgttg tgggaacctt catgcactct ctcatcttga 20760
ccccattcga gtcttggaag ttgacccaca gacaccacca caagaacacc ggaaacatcg 20820
atagagatga ggtgttctac ccacagagaa aggctgatga tcacccattg tccaggaact 20880
tgatcttggc tttgggagct gcttggcttg cttatttggt ggagggattc ccaccaagaa 20940
aggtgaacca cttcaaccca ttcgagccac tttttgtgag acaagtgtcc gctgtggtta 21000
tctctttgct cgctcacttc ttcgttgctg gactctctat ctacttgtct ctccagttgg 21060
gacttaagac catggctatc tactactacg gaccagtttt cgtgttcgga tctatgttgg 21120
tgattaccac cttcttgcac cacaacgatg aggagactcc atggtatgct gattctgagt 21180
ggacttacgt gaagggaaac ttgtcctctg tggatagatc ttacggtgct ctcatcgata 21240
acctctccca caacatcgga actcaccaga tccaccacct cttcccaatt atcccacact 21300
acaagctcaa gaaggctact gctgctttcc accaagcttt cccagagctt gtgagaaagt 21360
ccgatgagcc aatcatcaag gctttcttca gagtgggaag gttgtatgct aactacggag 21420
tggttgatca agaggctaag ctcttcactt tgaaggaggc taaggctgct actgaagctg 21480
ctgctaagac caagtctacc tgattaatga atcgacaagc tcgagtttct ccataataat 21540
gtgtgagtag ttcccagata agggaattag ggttcctata gggtttcgct catgtgttga 21600
gcatataaga aacccttagt atgtatttgt atttgtaaaa tacttctatc aataaaattt 21660
ctaattccta aaaccaaaat ccagtactaa aatccagatc ccccgaatta attcggcgtt 21720
aattcagcta cgtaggctca gctgagctta cctaaggcta cgtaggctca cgtgacgtta 21780
cgtaaggcta cgtagcgtca cgtgagctta cctaactcta gctagcctca cgtgacctta 21840
gctaacacta ggtagcgtca gcacagatga atactagctg ttgttcacag ttctagtgtc 21900
tcctcattac gtgaattcaa gctacgatca ctatctcaac tcctacataa acatcagaat 21960
gctacaaaac tatgcacaaa aacaaaagct acatctaata cgtgaatcaa ttactctcat 22020
cacaagaaag aagatttcaa tcaccgtcga gaaggaggat tcagttaatt gaatcaaagt 22080
tccgatcaaa ctcgaagact ggtgagcacg aggacgacga agaagagtgt ctcgaagata 22140
caacaagcaa gaaatctact gagtgacctc ctgaagttat tggcgcgatt gagagaatca 22200
atccgaatta atttcggga aaaagataaa ttagatacta agcgatgggc ttgggctggg 22260
ctaagaaaca ggtggcaatt gggctggagg accccgcgat tcatagcttc cgatagccca 22320
aaaaaaaacg gataacatat ttatcgggta tttgaatttc agtgaaataa gatattttct 22380
ttttgttagg aaaattttag aaaataatgg aaattaaata gcgattatgt tacaagatac 22440
gatcagcatc gggcagtgca aaatgctata gcttcccaag atttgatcct tttgggttat 22500
ctcctaatga caattagttt aggattttga aacttatatt aatactatta tccgacaaca 22560
cttgtttcag cttcttattt taacattttt tgtttttttc tattcttctt cccatcagca 22620
ttttcttttt aaaaaattga atactttaac tttttaaaaa tttcacaatg atcagatgat 22680
attatggaag atctcaagag ttaaatgtat ccatcttggg gcattaaaac cggtgtacgg 22740
gatgataaat acagacttta tatcatatga tagctcagta attcatattt atcacgttgc 22800
taaaaaaatt ataaggtact agtagtcaac aaaatcaatt aaagagaaag aaagaaacgc 22860
atgtgaagag agtttacaac tggaaaagta aaataaaaat taacgcatgt tgaatgctga 22920
catgtcagta tgtccatgaa tccacgtatc aagcgccatt catcgatcgt cttcctcttt 22980
ctaaatgaaa acaacttcac acatcacaac aaacaataca cacaagaccc cctctctctc 23040
gttgtctctc tgccagcgac caaatcgaag cttgagaaga acaagaaggg gtcaaaccat 23100

gggaaaagga tctgagggaa gatctgctgc tagagagatg actgctgagg ctaacggaga 23160
taagagaaag accatcctca ttgagggagt gttgtacgat gctaccaact tcaaacaccc 23220
aggaggttcc attattaact tcctcaccga gggagaagct ggagttgatg ctacccaagc 23280
ttacagagag ttccatcaga gatccggaaa ggctgataag tacctcaagt ccctcccaaa 23340
gttggatgct tctaaggtgg agtctaggtt ctctgctaag gagcaggcta gaagggacgc 23400
tatgaccagg gattacgctg ctttcagaga ggagttggtt gctgagggat acttcgatcc 23460
atctatccca cacatgatct acagagtggt ggagattgtg gctttgttcg ctttgtcttt 23520
ctggttgatg tctaaggctt ctccaacctc tttggttttg ggagtggtga tgaacggaat 23580
cgctcaagga agatgcggat gggttatgca cgagatggga cacggatctt tcactggagt 23640
tatctggctc gatgatagga tgtgcgagtt cttctacgga gttggatgtg gaatgtctgg 23700
acactactgg aagaaccagc actctaagca ccacgctgct ccaaacagat tggagcacga 23760
tgtggatttg aacaccttgc cactcgttgc tttcaacgag agagttgtga ggaaggttaa 23820
gccaggatct ttgttggctt tgtggctcag agttcaggct tatttgttcg ctccagtgtc 23880
ttgcttgttg atcggattgg gatggacctt gtacttgcac ccaagatata tgctcaggac 23940
caagagacac atggagtttg tgtggatctt cgctagatat atcggatggt tctccttgat 24000
gggagctttg ggatattctc ctggaacttc tgtgggaatg tacctctgct ctttcggact 24060
tggatgcatc tacatcttcc tccaattcgc tgtgtctcac acccacttgc cagttaccaa 24120
cccagaggat caattgcact ggcttgagta cgctgctgat cacaccgtga acatctctac 24180
caagtcttgg ttggttacct ggtggatgtc taacctcaac ttccaaatcg agcaccactt 24240
gttcccaacc gctccacaat tcaggttcaa ggagatctct ccaagagttg aggctctctt 24300
caagagacac aacctccctt actacgattt gccatacacc tctgctgttt ctactacctt 24360
cgctaacctc tactctgttg gacactctgt tggagctgat accaagaagc aggattgatg 24420
attaatgaat aattgattgt acatactata ttttttgttt accttgtgtt agtttaatgt 24480
tcagtgtcct ctctttattg tggcacgtct ctttgttgta tgttgtgtct atacaaagtt 24540
gaaataatgg aaagaaaagg aagagtgtaa tttgttttgt tttaagtgtt tataaatata 24600
tatatatagg tcatttagat agttctaggt ttctataaaa ctctctctct ggaagtagaa 24660
tctgtttttg agaggatcca gttgcctact aatctccccc aaaacccttc aagcttaacc 24720
ttcctcttca caacaacaga ggaaacacat ctcttgagct ctgagttctc ttctttgagc 24780
atgtctatcg ctaaactcat ctgccttata gcttccctct tctcttcatc tctctctctc 24840
accatttcgc tgtaaaactt attctcctcc ctcagcctct ctatctcttc cttcagcatc 24900
tcacaattcc caccataatc gactgaggat gattcaccgt catcaacttc agactcagcg 24960
ttgtagtcgt catgagtctc acaagccttg gaccaagaag actcatcatc gcaagttgat 25020
gatttatcat gatgcttctc tgagccgtgt ttgctaccta gagtcagctg agcttagcta 25080
acgctagcta gtgtcagctg acgttacgta aggctaacta gcgtcacgtg accttacgta 25140
acgctacgta ggctcagctg agcttagcta accctagcta gtgtcacgtg agcttacgct 25200
actatagaaa atgtgttata tcgacatgac cagacaaagg ggcaacagtt aacaaaacaa 25260
ttaattcttt catttgagat taaggaaggt aaggtactaa aaagattaaa aaaaatgagc 25320
ttatctcttt gtttctgtaa taataatata agtgtgataa acttttaata taataattgt 25380
aattaggttt tctacagatg agcaccactc agagacaaga taagaagaaa acaattttgt 25440
taaacatgat tatagaaact tttagttaag tcttgaagta tcaatataac aaaaaaaagt 25500
acacacgact atgacaataa acccactacc gtcaggttat catttcgatg aaatgttttg 25560
atatcattaa atataacagt cacaaaaaat catctaatta taacaatata acttatacat 25620
atatttaact aaaaacttag agtttttgta atgattctaa ttgatgatta gagtttatag 25680
aaatacaatt aaataaaaaa tataatttta aaaaaacata gtaaagtcaa tgagatcctc 25740
tctgacctca gtgatcattt agtcatgtat gtacaacaat cattgttcat cacatgactg 25800
taaaataaat aaggataaac ttgggaatat atataatata ttgtattaaa taaaaaaggg 25860
aaatacaaat atcaatttta gattcccgag ttgacacaac tcaccatgca cgctgccacc 25920
tcagctccca gctctcgtca catgtctcat gtcagttagg tctttggttt ttagtctttg 25980
acacaactcg ccatgcatgt tgccacgtga gctcgttcct cttcccatga tctcaccact 26040
gggcatgcat gctgccacct cagctggcac ctcttctcta tatgtcccta gaggccatgc 26100
acagtgccac ctcagcactc ctctcagaac ccatacgtac ctgccaatcg gcttctctcc 26160
ataaatatct atttaaatta taactaatta tttcatatac ttaattgatg acgtggatgc 26220
attgccatcg ttgtttaata attgttaatt acgacatgat aaataaaatg aaagtaaaaa 26280
gtacgaaaga ttttccattt gttgttgtat aaatagagaa gtgagtgatg cataatgcat 26340
gaatgcatga ccgcgccacc atgactgttg gatacgacga ggagatccca ttcgagcaag 26400
ttagggctca taacaagcca gacgacgctt ggtgtgctat tcacggacac gtgtacgacg 26460
ttaccaagtt cgcttcagtt cacccaggag gagatattat cttgctcgct gctggaaagg 26520
aagctactgt cctctacgag acctaccatg ttagaggagt gtctgacgct gtgctcagaa 26580
agtacagaat aggaaagttg ccagacggac aaggaggagc taacgagaag gagaagagaa 26640
ccttgtctgg attgtcctct gcttcttact acacctggaa ctccgatttc tacagagtga 26700
tgagggagag agttgtggct agattgaagg agagaggaaa ggctagaaga ggaggatacg 26760
aactctggat caaggctttc ttgctccttg ttggattctg gtcctctctt tactggatgt 26820
gcaccctcga tccatctttc ggagctatct tggctgctat gtctttggga gtgttcgctg 26880
cttttgttgg aacctgcatc caacacgatg gaaaccacgg agctttcgct caatctagat 26940
gggttaacaa ggtggcagga tggactttgg atatgatcgg agcttctgga atgacttggg 27000
agttccaaca cgtgttggga caccacccat acactaactt gatcgaggag gagaacggat 27060
tgcaaaaggt gtccggaaag aagatggata ccaagttggc tgatcaagag tctgatccag 27120
atgtgttctc cacctaccca atgatgagat tgcacccttg gcaccagaag aggtggtatc 27180

acaggttcca gcacatctac ggacctttca tcttcggatt catgaccatc aacaaggtgg 27240
tgactcaaga tgttggagtg gtgttgagaa agagactctt ccaaatcgat gctgagtgca 27300
gatatgcttc cccaatgtac gttgctaggt tctggattat gaaggctttg accgtgttgt 27360
atatggttgc tttgccttgt tatatgcaag gaccttggca cggattgaaa ctcttcgcta 27420
tcgctcactt cacttgcgga gaggttttgg ctaccatgtt catcgtgaac cacattatcg 27480
agggagtgtc ttacgcttct aaggatgctg ttaagggaac tatggctcca ccaaagacta 27540
tgcacggagt gaccccaatg aacaacacta gaaaggaggt tgaggctgag gcttctaagt 27600
ctggagctgt ggttaagtct gtgccattgg atgattgggc tgctgttcag tgccaaacct 27660
ctgtgaactg gtctgttgga tcttggtttt ggaaccactt ctctggagga ctcaaccacc 27720
aaatcgagca ccacctcttc ccaggattgt ctcacgagac ctactaccac atccaagacg 27780
tggttcaatc tacctgtgct gagtacggag ttccatacca acacgagcca tctttgtgga 27840
ctgcttactg gaagatgctc gaacacctta gacaattggg aaacgaggag actcacgagt 27900
catggcagag agctgcttga ttaatgaact aagactccca aaaccacctt ccctgtgaca 27960
gttaaaccct gcttatacct ttcctcctaa taatgttcat ctgtcacaca aactaaaata 28020
aataaaatgg gagcaataaa taaaatggga gctcatatat ttacaccatt tacactgtct 28080
attattcacc atgccaatta ttacttcata attttaaaat tatgtcattt ttaaaaattg 28140
cttaatgatg gaaaggatta ttataagtta aaagtataac atagataaac taaccacaaa 28200
acaaatcaat ataaactaac ttactctccc atctaatttt tatttaaatt tctttacact 28260
tctcttccat ttctatttct acaacattat ttaacatttt tattgtattt ttcttacttt 28320
ctaactctat tcatttcaaa aatcaatata tgtttatcac cacctctcta aaaaaaactt 28380
tacaatcatt ggtccagaaa agttaaatca cgagatggtc attttagcat taaaacaacg 28440
attcttgtat cactattttt cagcatgtag tccattctct tcaaacaaag acagcggcta 28500
tataatcgtt gtgttatatt cagtctaaaa caactagcta gcctcagctg acgttacgta 28560
acgctaggta gcgtcacgtg acgttagcta acgctaggta gcgtcagctg agcttacgta 28620
agcgccacgg gcaggacata gggactacta caagcatagt atgcttcaga caaagagcta 28680
ggaaagaact cttgatggag gttaagagaa aaaagtgcta gaggggcata gtaatcaaac 28740
ttgtcaaaac cgtcatcatg atgagggatg acataatata aaaagttgac taaggtcttg 28800
gtagtactct ttgattagta ttatatattg gtgagaacat gagtcaagag gagacaagaa 28860
accgaggaac catagtttag caacaagatg gaagttgcaa agttgagcta gccgctcgat 28920
tagttacatc tcctaagcag tactacaagg aatggtctct atactttcat gtttagcaca 28980
tggtagtgcg gattgacaag ttagaaacag tgcttaggag acaaagagtc agtaaaggta 29040
ttgaaagagt gaagttgatg ctcgacaggt caggagaagt ccctccgcca gatggtgact 29100
accaaggggt tggtatcagc tgagacccaa ataagattct tcggttgaac cagtggttcg 29160
accgagactc ttagggtggg atttcactgt aagatttgtg cattttgttg aatataaatt 29220
gacaattttt tttatttaat tatagattat ttagaatgaa ttacatattt agtttctaac 29280
aaggatagca atggatgggt atgggtacag gttaaacata tctattaccc acccatctag 29340
tcgtcgggtt ttacacgtac ccacccgttt acataaacca gaccggaatt ttaaaccgta 29400
cccgtccgtt agcgggtttc agatttaccc gtttaatcgg gtaaaacctg attactaaat 29460
atatattttt tatttgataa acaaaacaaa aatgttaata ttttcatatt ggatgcaatt 29520
ttaagaaaca catattcata aatttccata tttgtaggaa aataaaaaga aaaatatatt 29580
caagaacaca aatttcaccg acatgacttt tattacagag ttggaattag atctaacaat 29640
tgaaaaatta aaattaagat agaatatgtt gaggaacatg acatagtata atgctgggtt 29700
acccgtcggg taggtatcga ggcggatact actaaatcca tcccactcgc tatccgataa 29760
tcactggttt cgggtatacc cattcccgtc aacaggcctt tttaaccgga taatttcaac 29820
ttatagtgaa tgaattttga ataaatagtt agaataccaa aatcctggat tgcatttgca 29880
atcaaatttt gtgaaccgtt aaattttgca tgtacttggg atagatataa tagaaccgaa 29940
ttttcattag tttaatttat aacttacttt gttcaaagaa aaaaaatatc tatccaattt 30000
acttataata aaaaataatc tatccaagtt acttattata atcaacttgt aaaaaggtaa 30060
gaatacaaat gtggtagcgt acgtgtgatt atatgtgacg aaatgttata tctaacaaaa 30120
gtccaaattc ccatggtaaa aaaaatcaaa atgcatggca ggctgtttgt aaccttggaa 30180
taagatgttg gccaattctg gagccgccac gtacgcaaga ctcagggcca cgttctcttc 30240
atgcaaggat agtagaacac cactccaccc acctcctata ttagaccttt gcccaacccct 30300
ccccaacttt cccatcccat ccacaaagaa accgacattt ttatcataaa tcaggtttc 30360
gtttttgttt catcgataaa ctcaaaggtg atgattttag ggtcttgtga gtgtgctttt 30420
ttgtttgatt ctactgtagg gtttatgttc tttagctcat aggttttgtg tatttcttag 30480
aaatgtggct tctttaatct ctgggtttgt gactttttgt gtggtttctg tgtttttcat 30540
atcaaaaacc tattttttcc gagttttttt ttacaaattc ttactctcaa gcttgaatac 30600
ttcacatgca gtgttctttt gtagatttta gagttaatgt gttaaaaagt ttggattttt 30660
cttgcttata gagcttcttc actttgattt tgtgggtttt tttgttttaa aggtgagatt 30720
tttgatgagg tttttgcttc aaagatgtca cctttctggg tttgtctttt gaataaagct 30780
atgaactgtc acatggctga cgcaattttg ttactatgtc atgaaagctg acgtttttcc 30840
gtgttataca tgtttgctta cacttgcatg cgtcaaaaaa attggggctt tttagtttta 30900
gtcaaagatt ttacttctct tttgggattt atgaaggaaa gttgcaaact ttctcaaatt 30960
ttaccatttt tgctttgatg tttgtttaga ttgcgacaga acaaactcat atatgttgaa 31020
atttttgctt ggttttgtat aggattgtgt cttttgctta taaatgttga aatctgaact 31080
tttttttgt ttggtttctt tgagcaggag ataaggcgca ccaccatggc ttctacatct 31140
gctgctcaag acgctgctcc ttacgagttc ccttctctca ctgagatcaa gagggctctt 31200
ccttctgagt gtttcgaggc ttctgttcct ctttctctct actacaccgc tagatctctt 31260

gctcttgctg gatctctcgc tgttgctctc tcttacgcta gagctttgcc tcttgttcag 31320
gctaacgctc ttcttgatgc tactctctgc actggatacg ttcttctcca gggaatcgtt 31380
ttctggggat tcttcaccgt tggtcacgat tgtggacacg gagctttctc tagatctcac 31440
gtgctcaact tctctgttgg aaccctcatg cactctatca tccttacccc tttcgagtct 31500
tggaagctct ctcacagaca ccaccacaag aacaccggaa acatcgataa ggacgagatc 31560
ttctaccctc aaagagaggc tgattctcac cctgtttcta gacaccttgt gatgtctctt 31620
ggatctgctt ggttcgctta ccttttcgct ggattccctc ctagaaccat gaaccacttc 31680
aacccttggg aggctatgta tgttagaaga gtggctgctg tgatcatctc tctcggagtt 31740
cttttcgctt tcgctggact ctactcttac ctcaccttcg ttcttggatt caccactatg 31800
gctatctact acttcggacc tctcttcatc ttcgctacca tgcttgttgt taccactttc 31860
ctccaccaca acgatgagga gacaccttgg tacgctgatt ctgagtggac ttacgtgaag 31920
ggaaacctct cttctgtgga cagatcttac ggtgctctca tcgacaacct tagccacaac 31980
atcggaactc accagatcca ccacctcttc cctatcatcc ctcactacaa gctcaacgat 32040
gctactgctg ctttcgctaa ggctttccct gagcttgtta ggaaaaacgc tgctcctatc 32100
atcccaactt tcttcaggat ggctgctatg tacgctaagt acggagttgt tgacactgat 32160
gctaagacct tcactctcaa ggaggctaag gctgctgcta agactaagtc atcttgatga 32220
ttaatgaagg ccgcagatat cagatctggt cgacctagag gatccccggc cgcaaagata 32280
ataacaaaag cctactatat aacgtacatg caagtattgt atgatattaa tgtttttacg 32340
tacgtgtaaa caaaaataat tacgtttgta acgtatggtg atgatgtggt gcactaggtg 32400
taggccttgt attaataaaa agaagtttgt tctatataga gtggtttagt acgacgattt 32460
atttactagt cggattggaa tagagaaccg aattcttcaa tccttgcttt tgatcaagaa 32520
ttgaaaccga atcaaatgta aaagttgata tatttgaaaa acgtattgag cttatgaaaa 32580
tgctaatact ctcatctgta tggaaaagtg actttaaaac cgaacttaaa agtgacaaaa 32640
ggggaatatc gcatcaaacc gaatgaaacc gatctacgta ggctcagctg agcttaccta 32700
aggctacgta ggctcacgtg acgttacgta aggctacgta gcgtcacgtg agcttaccta 32760
actctagcta gcctcacgtg accttagcta acactaggta gcgtcagctt agcagatatt 32820
tggtgtctaa atgtttattt tgtgatatgt tcatgtttga aatggtggtt tcgaaaccag 32880
ggacaacgtt gggatctgat agggtgtcaa agagtattat ggattgggac aatttcggtc 32940
atgagttgca aattcaagta tatcgttcga ttatgaaaat tttcgaagaa tatcccattt 33000
gagagagtct ttacctcatt aatgttttta gattatgaaa ttttatcata gttcatcgta 33060
gtctttttgg tgtaaaggct gtaaaaagaa attgttcact tttgttttcg tttatgtgaa 33120
ggctgtaaaa gattgtaaaa gactattttg gtgttttgga taaaatgata gtttttatag 33180
attcttttgc ttttagaaga aatacatttg aaattttttc catgttgagt ataaaatacc 33240
gaaatcgatt gaagatcata gaaatatttt aactgaaaac aaatttataa ctgattcaat 33300
tctctccatt tttatacctа tttaaccgta atcgattcta atagatgatc gatttttat 33360
ataatcctaa ttaaccaacg gcatgtattg gataattaac cgatcaactc tcacccctaa 33420
tagaatcagt attttccttc gacgttaatt gatcctacac tatgtaggtc atatccatcg 33480
ttttaatttt tggccaccat tcaattctgt cttgccttta gggatgtgaa tatgaacggc 33540
caaggtaaga gaataaaaat aatccaaatt aaagcaagag aggccaagta agataatcca 33600
aatgtacact tgtcattgcc aaaattagta aaatactcgg catattgtat tcccacacat 33660
tattaaaata ccgtatatgt attggctgca tttgcatgaa taatactacg tgtaagccca 33720
aaagaaccca cgtgtagccc atgcaaagtt aacactcacg accccattcc tcagtctcca 33780
ctatataaac ccaccatccc caatctcacc aaacccacca cacaactcac aactcactct 33840
cacaccttaa agaaccaatc accaccaaaa aaagttcttt gctttcgaag ttgccgcaac 33900
ctaaacaggt ttttccttct tctttcttct tattaactac gaccttgtcc tttgcctatg 33960
taaaattact aggttttcat cagttacact gattaagttc gttatagtgg aagataaaat 34020
gccctcaaag cattttgcag gatatctttg atttttcaaa gatatggaac tgtagagttt 34080
gatagtgttc ttgaatgtgg ttgcatgaag ttttttttggt ctgcatgtta tttttttcctc 34140
gaaatatgtt ttgagtccaa caagtgattc acttgggatt cagaaagttg ttttctcaat 34200
atgtaacagt ttttttctat ggagaaaaat catagggacc gttggttttg gcttctttaa 34260
ttttgagctc agattaaacc cattttaccc ggtgttcttg gcagaattga aaacagtacg 34320
tagtaccgcg cctaccatgc cacctagtgc tgctagtgaa ggtggtgttg ctgaacttag 34380
agctgctgaa gttgctagct acactagaaa ggctgttgac gaaagacctg acctcactat 34440
agttggtgac gctgtttacg acgctaaggc ttttagggac gagcaccctg gtggtgctca 34500
cttcgttagc cttttcggag gtagggacgc tactgaggct tttatggaat atcaccgtag 34560
agcttggcct aaggctagga tgtctaagtt cttcgttggt tcacttgacg ctagcgagaa 34620
gcctactcaa gctgattcag cttaccttag actttgcgct gaggttaacg ctcttttgcc 34680
taagggtagc ggaggattcg ctcctcctag ctactggctt aaggctgctg ctcttgttgt 34740
tgctgctgtt agtatagagg gttatatgct ccttaggggt aagacccttt tgcttagcgt 34800
tttccttgga ctcgtgttcg cttggatagg acttaatatt cagcacgacg ctaatcacgg 34860
tgctcttagt agacactcag tgattaacta ctgcctcggt tacgctcagg attggatagg 34920
tggtaatatg gtgctttggc ttcaagagca cgttgtgatg caccacctcc acactaacga 34980
cgttgacgct gatcctgatc aaaaggctca cggtgttctt agacttaagc ctactgacgg 35040
ttggatgcct tggcacgcac ttcaacaact ctatatcctt cctggtgagg ctatgtacgc 35100
ttttaagctt cttttcttgg acgcccttga gcttcttgct tggaggtggg agggtgagaa 35160
gattagccct cttgctagag ctttgttcgc tcctgctgtt gcttgtaagc ttggattctg 35220
ggctagattc gttgctctcc ctctctggct tcaacctact gttcacactg ctttgtgtat 35280
ctgtgctact gtgtgtactg gtagcttcta cctcgccttc ttcttcttta tctctcacaa 35340

cttcgacggt gttggtagcg ttggacctaa gggatcactt cctagatcag ctactttcgt 35400
tcaacgtcag gttgagacta gctctaacgt tggtggttac tggcttggag ttcttaacgg 35460
tggacttaac tttcagatag agcaccactt gttccctagg cttcaccact cttactacgc 35520
tcaaatagct cctgtggtta ggactcacat agagaagctc ggttttaagt accgtcactt 35580
ccctaccgtt ggatctaacc ttagctcaat gcttcagcat atgggtaaga tgggaactag 35640
acctggtgct gagagggtg gtaaggctga gtagtgatta atgaataatt gattgctgct 35700
ttaatgagat atgcgagacg cctatgatcg catgatattt gctttcaatt ctgttgtgca 35760
cgttgtaaaa aacctgagca tgtgtagctc agatccttac cgccggtttc ggttcattct 35820
aatgaatata tcacccgtta ctatcgtatt tttatgaata atattctccg ttcaatttac 35880
tgattgtcta cgtagcgtca cctgacgtta cgtaaggcta cctaggctca cgtgacgtta 35940
cgtaacgcta cgtagcgtca ggtgaggtta gctaacgcta gctagcctca cctgacgtta 36000
ggtaaggcta cgtagcgtca cctgagatta gctaagccta cctagactca cgtgacctta 36060
ggtaacgcta cgtagcgtca aagctttaca acgctacaca aaacttataa ccgtaatcac 36120
cattcattaa cttaactact atcacatgca ttcatgaatt gaaacgagaa ggatgtaaat 36180
agttgggaag ttatctccac gttgaagaga tcgttagcga gagctgaaag accgagggag 36240
gagacgccgt caacacggac agagtcgtcg accctcacat gaagtaggag gaatctccgt 36300
gaggagccag agagacgtct ttggtcttcg gtttcgatcc ttgatctgac ggagaagacg 36360
agagaagtgc gactggactc cgtgaggacc aacagagtcg tcctcggttt cgatcgtcgg 36420
tattggtgga gaaggcggag gaatctccgt gacgagccag agagatgtcg tcggtcttcg 36480
gtttcgatcc ttgatctgac ggagaagacg agagaagtgc gacgagactc cgtgaggacc 36540
aacagagttg tcctcggttt cgatcgtcgg tttcggcgga gaaggcggag gaatctccgt 36600
gaggagccag agagacgtcg ttggtcttcg gtttcgatcc ttgatctgtt ggagaagacg 36660
agacaagtgg gacgagactc aacgacggag tcagagacgt cgtcggtctt cggtttcggc 36720
cgagaaggcg gagtcggtct tcggtttcgg ccgagaaggc ggaggagacg tcttcgattt 36780
gggtctctcc tcttgacgaa gaaaacaaag aacacgagaa ataatgagaa agagaacaaa 36840
agaaaaaaaa ataaaaataa aaataaaatt tggtcctctt atgtggtgac acgtggtttg 36900
aaacccacca aataatcgat cacaaaaaac ctaagttaag gatcggtaat aacctttcta 36960
attaattttg atttatatta aatcactctt tttatttata aaccccacta aattatgcga 37020
tattgattgt ctaagtacaa aaattctctc gaattcaata cacatgtttc atatatttag 37080
ccctgttcat ttaatattac tagcgcattt ttaatttaaa attttgtaaa cttttttggt 37140
caaagaacat ttttttaatt agagacagaa atctagactc tttatttgga ataatagtaa 37200
taaagatata ttaggcaatg agtttatgat gttatgttta tatagtttat ttcattttaa 37260
attgaaaagc attattttta tcgaaatgaa tctagtatac aatcaatatt tatgtttttt 37320
catcagatac tttcctattt tttggcacct ttcatcggac tactgattta tttcaatgtg 37380
tatgcatgca tgagcatgag tatacacatg tcttttaaaa tgcatgtaaa gcgtaacgga 37440
ccacaaaaga ggatccatac aaatacatct catcgcttcc tctacta 37487

<210> 309
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 2 RB junction region

<400> 309
caccctggct ttggggtgag 20

<210> 310
<211> 20
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 2 LB junction region

<400> 310
tcctctacta ttctccgaca 20

<210> 311
<211> 5600
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 2 flanking sequence up to and including the right
border of the T-DNA

<400> 311
attttagatt tagtcatatt tttaacttaa ttattaatta taataaatat ttttagtgat 60
ttagatgata aattttcatt gtcttgagaa taataaaaaa aaaatctaag gataatatca 120
tagttaaatt tatatgatat ttacttcagt aatattaaaa tattatatac atttttatta 180
tatttggttt agtaatatta aatggattct attttaaatt tcttatgaca atcaaaacca 240
cttagtgtga taatttctga aaaaaattgg caaaaaaatc aaaaatactt atcttattat 300
ttgtagtgat ttttctctct ctcatgttaa aattttgaat gtttaaagtc tttattatct 360
ttaataaata attagattaa atttttaata tataattacc cataatttaa aacaaatttc 420
attaatttta aaatcatcat tatctaaaaa gattatatat tatgttatcc aaaaatattt 480
tacatcataa tattttaaaa taaatataaa tttatgtata ttgttttatg tatatatgaa 540
tgtttttaag tttattttac ataatcaaat atattttaca aaaataattt ttatcatata 600
taaaatttaa catttaatta attattaaat atttcaaaag tatgaatata acttattctc 660
atggttttta attgataata tatctattta caattttttg taaaattatt aaacccgcaa 720
gtatggacaa aacacctagt atatatattt ggaacaaaga atacagacaa aacacctagt 780
atatatattt ggaacaaaaa atatacgtac atattttata tacatgaata acttatatat 840
cacttagaaa taggataatc aattgacatt aaactctctt aaattatata ttgtatagaa 900
ctatagatat acgtataaaa tatttataaa agataactac actatatata gaaacagata 960
atgatacatc cacgaaaatt cttctggaaa agaaacagag tggtttcgcg tcagcacacc 1020
tacgttgatc attggaaatt ggaatattga aacacgcttc aaatcaacga ctattaatta 1080
ccaatacacc ctggctttgg ggtgagagtt gatcggttaa ttatccaata catgccgttg 1140
gttaattagg attatataaa aaatcgatca tctattagaa tcgattacgg ttaaataggt 1200
ataaaaatgg agagaattga atcagttata aatttgtttt cagttaaaat atttctatga 1260
tcttcaatcg atttcggtat tttatactca acatggaaaa aatttcaaat gtatttcttc 1320
taaaagcaaa agaatctata aaaactatca ttttatccaa aacaccaaaa tagtctttta 1380
caatctttta cagccttcac ataaacgaaa acaaaagtga acaatttctt tttacagcct 1440
ttacaccaaa aagactacga tgaactatga taaaatttca taatctaaaa acattaatga 1500
ggtaaagact ctctcaaatg ggatattctt cgaaaatttt cataatcgaa cgatatactt 1560
gaatttgcaa ctcatgaccg aaattgtccc aatccataat actctttgac accctatcag 1620
atcccaacgt tgtccctggt ttcgaaacca ccatttcaaa catgaacata tcacaaaata 1680
aacatttaga caccaaatat ctgctaagcg cttacgtaag ctcagctgac gctacctagc 1740
gttagctaac gtcacgtgac gctacctagc gttacgtaac gtcagctgag gctagctagc 1800
tgaattaacg ccgaattaat tcgggggatc tggattttag tactggattt tggttttagg 1860
aattagaaat tttattgata gaagtatttt acaaatacaa atacatacta agggtttctt 1920
atatgctcaa cacatgagcg aaaccctata ggaaccctaa ttcccttatc tgggaactac 1980
tcacacatta ttatggagaa actcgagctt gtcgatcact cggtcttagc tccctttttgc 2040
tttccatcgg atggcttgat gtacttttgc acgtagaagt ttccgaagag gaacaagagg 2100
gagatcatgt agtagaagag gatcttgatg agccattgtg gatatggagc gttggttttc 2160
atatcgtagt aagcttgcac caagttgagc atgaactgga acatctggaa ttgggtgagg 2220
tatcttcccc agaagaggta cttgttcttg agctttgggg aagatctcaa gcaagcagcc 2280
aagaagtagt aagcgtacat caacacgtgc actccagagt tgagagcagc actccaataa 2340
gcctctcctc ctggagcgtg gtgagcaata gcccaccaga taagggagat agaagagtgg 2400
tggtacacgt ggaggaaaga aatctgtctg gtggatctct tgaggatcat gatcacggta 2460
tccatgaact ccacgtactt ggacatgtag aagaggtaaa cgaggatagc catctccttg 2520
tgctttgggt tataagcgtt tccccacaag gaatatctcc aggtgatagc ttggtaagcg 2580
atacccacgc acatgtaaag agacaaagcg aagcagaaca agttgtgcac caacaccaaa 2640
gcttgcaaca agaatggctc agaagctctt ggcttgagat ctctagcctt gatccaaagc 2700
aatcctccga tcacgatggt caagtaaaca gacactccca acacaattgg agttggagaa 2760
tcaacgagtg gcaatccctt agtagttggg gtatcagtca actcaactcc gaaagatccc 2820
aacaaagcgt tcactccttg ggaaaccttt ccatccaact ctccgtagaa cctctcaaca 2880
acttccatgg tttcttctaa agctgaaagt gaaccattat tacaacttaa cactcaactc 2940
acaagaggag aagcaacaaa gcttatgtaa ggatttagta ttaaggccaa aaaaacacag 3000
atcaaattca attattgaag ctttacttat caagttatca tataaccaat gaagacggta 3060
attcaaaaga aaaataaaag ggtttgtaga ataattgata cgtttacctt tgccgattca 3120
gagacagtga agcttaaaca gtactggcta tgaagaaatt ataatcgtgt aaaacttagt 3180
gagtgtgtat gaatgaaagt attgcaaaat cctcattata tagactacat gcataactag 3240
ttgcatgtaa atttgtagtt ttcttcatta ttgcatcctc caagtggatg tcatggtttt 3300
acacatggct tccatgcaaa tcatttccaa aatattttta aactttccac agggcatcca 3360
tgcatgcacc tcaaaacttg tgtgtggtaa cattgttgtc ttgaaaaatt actaaacctt 3420
ttgtccacgt gacgttcatg cacctcaaat cttgtgtggt accattatta tcctcaagaa 3480
ttattgaatg tttggtgtat atgccatcca tgcagcattg caacaattaa atctccaaac 3540
cttgtggtac catattcact cactttaatt ctcctatagt agaaatatta gcaaatattt 3600
acatttccag ttgattagta tatgtattta gaagacaaaa ataatttaga atcaattaat 3660
caacttgcaa attgctaagt gttggcaaac gttagcataa aaggtgttat aaatttagta 3720
ccaaatataa aaatttatcg caaatcaaat acataacaca catagtaaaa caaaaacaaa 3780
ttacaagggt ttagacgttt agtggcaatg tgtaaatttg ctgcaggagt gacgctagct 3840
agcgttacgt aacgtcagct gagcctaggt agcgttagct aagctcacgt gacgctacgt 3900
aggcttacgt aacgtcagct gaggctacgt agcgttagct aacgtcacgt gacgctacgt 3960
aggcttacgt aatagttact aatcagtgat caggcgcgcc attaatttcc accttcacct 4020

acgatggggg gcatcgcacc ggtgagtaat attgtacggc taagagcgaa tttggcctgt 4080
agacctcaat tgcgagcttt ctaatttcaa actattcggg cctaactttt ggtgtgatga 4140
tgctgactgt ttcgacgtta attgatccta cactatgtag gtcatatcca tcgttttaat 4200
ttttggccac cattcaattc tgtcttgcct ttagggatgt gaatatgaac ggccaaggta 4260
agagaataaa aataatccaa attaaagcaa gagaggccaa gtaagataat ccaaatgtac 4320
acttgtcatt gccaaaatta gtaaaatact cggcatattg tattcccaca cattattaaa 4380
ataccgtata tgtattggct gcatttgcat gaataatact acgtgtaagc ccaaaagaac 4440
ccacgtgtag cccatgcaaa gttaacactc acgaccccat tcctcagtct ccactatata 4500
aacccaccat ccccaatctc accaaaccca ccacacaact cacaactcac tctcacacct 4560
taaagaacca atcaccacca aaaaatttca cgatttggaa tttgattcct gcgatcacag 4620
gtatgacagg ttagattttg ttttgtatag ttgtatacat acttctttgt gatgttttgt 4680
ttacttaatc gaatttttgg agtgttttaa ggtctctcgt ttagaaatcg tggaaaatat 4740
cactgtgtgt gtgttcttat gattcacagt gtttatgggt ttcatgttct ttgttttatc 4800
attgaatggg aagaaatttc gttgggatac aaatttctca tgttcttact gatcgttatt 4860
aggagtttgg ggaaaaagga agagtttttt tggttggttc gagtgattat gaggttattt 4920
ctgtatttga tttatgagtt aatggtcgtt ttaatgttgt agacatggga aaaggatctg 4980
agggaagatc tgctgctaga gagatgactg ctgaggctaa cggagataag agaaagacca 5040
tcctcattga gggagtgttg tacgatgcta ccaacttcaa acacccagga ggttccatta 5100
ttaacttcct caccgaggga gaagctggag ttgatgctac ccaagcttac agagagttcc 5160
atcagagatc cggaaaggct gataagtacc tcaagtccct cccaaagttg gatgcttcta 5220
aggtggagtc taggttctct gctaaggagc aggctagaag ggacgctatg accagggatt 5280
acgctgcttt cagagaggag ttggttgctg agggatactt cgatccatct atcccacaca 5340
tgatctacag agtggtggag attgtggctt tgttcgcttt gtctttctgg ttgatgtcta 5400
aggcttctcc aacctctttg gttttgggag tggtgatgaa cggaatcgct caaggaagat 5460
gcggatgggt tatgcacgag atgggacacg gatctttcac tggagttatc tggctcgatg 5520
ataggatgtg cgagttcttc tacggagttg gatgtggaat gtctggacac tactggaaga 5580
accagcactc taagcaccac 5600

<210> 312
<211> 1321
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 2 flanking sequence up to and including the left
border of the T-DNA

<400> 312
taaagatata ttaggcaatg agtttatgat gttatgttta tatagtttat ttcattttaa 60
attgaaaagc attattttta tcgaaatgaa tctagtatac aatcaatatt tatgtttttt 120
catcagatac tttcctattt tttggcacct ttcatcggac tactgattta tttcaatgtg 180
tatgcatgca tgagcatgag tatacacatg tcttttaaaa tgcatgtaaa gcgtaacgga 240
ccacaaaaga ggatccatac aaatacatct catcgcttcc tctactattc tccgacacac 300
acactgagca tggtgcttaa acactctggt gagttctagt acttctgcta taatgttaaa 360
ttttatatta tatacctact tcctctctct cgctctgtta tgttcgattt cgaaaggatt 420
tcaagatcaa agatgatgag aaaaggtacc ttttcgatat ttaagacaag gaaagaaagg 480
acgaggttga aattttcggg acttggaggg ctaaagtgga agagactgaa tctgaagatg 540
tcgtttctcg aaactttgag atacagaatc atgtctatca ttgaaggaat ggttttggtt 600
tctaagcttg ctttcttctt tctctgttgc ggttgcagat tttaacacgt tagttttttt 660
tttttcgttt ttttgaacgt caacaatgtc ttttttgtac tctttagctc atgtgtaaaa 720
ttctaaattc ttccaataac atacccaaca aattattcgt atctgatttt tatagttttt 780
aacctgttaa tgtaattaat ctaagtgtaa tttttaggct aaatgttaaa ttttatatta 840
aagttttgta acttgaaatt acattcttct tatagcggat aaacagaaaa tgctcttaaa 900
caaatcctga aacaagtaaa aaatacaaca gaaaaatcta acgtttaatt cttaaaacct 960
caaaatcctt atttttacag ctttcaaagt ttaacagctg gaaacctgta gaaaatcaga 1020
cacagcctct caagttttct ggacaataaa tactggtaac gtaagaaaac caattaatga 1080
taccgtcgtt cagtagatag aactgacgat gtgaagatta attgtttctg taatatactg 1140
aatttgaaaa tttatcatca tcatgttaac ggaagttgtc tgtaaaagta gttgattacc 1200
tgttatcgtg taaagtagtt agtaatttct tgcttatttg aaaaatagag aacatttaac 1260
atgtattttt aaataggcac gaccatgcta ctgaacttta tgaaatgctt tggaatctta 1320
t 1321

<210> 313
<211> 23
<212> DNA
<213> Artificial sequence

<220>

<223> LBFDAU Locus 2_Forward primer

<400> 313
cactgagcat ggtgcttaaa cac 23

<210> 314
<211> 29
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU Locus 2_Reverse primer

<400> 314
agagcgagag agaggaagta ggtatataa 29

<210> 315
<211> 19
<212> DNA
<213> Artificial sequence

<220>
<223> LBFDAU locus 2_Probe

<400> 315
ctggtgagtt ctagtactt 19

<210> 316
<211> 19
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFLFK Locus 1

<400> 316
agaagtgtac gcgacgaga 19

<210> 317
<211> 21
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFLFK Locus 1

<400> 317
tcaggagcga gaatgcgaaa g 21

<210> 318
<211> 21
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFLFK Locus 2

<400> 318
acccatacat acgcataagt g 21

<210> 319
<211> 19
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFLFK Locus 2

<400> 319
aatatatggg ctacattga 19

<210> 320
<211> 18
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFDAU Locus 1

<400> 320
ggcaggcgtg atcttatt 18

<210> 321
<211> 21
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFDAU Locus 1

<400> 321
cataatttgc agtcgctgat t 21

<210> 322
<211> 21
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFDAU Locus 2

<400> 322
agataacgat acatccacga a 21

<210> 323
<211> 21
<212> DNA
<213> Artificial sequence

<220>
<223> Primer for determining zygosity of LBFDAU Locus 2

<400> 323
cgaacataac agagcgagag a 21

<210> 324
<211> 1197
<212> DNA
<213> Artificial Sequence

<220>
<223> d12Des(Ps) on LBFLFK Locus 1

<400> 324
atggctattt tgaaccctga ggctgattct gctgctaacc tcgctactga ttctgaggct 60
aagcaaagac aattggctga ggctggatac actcacgttg agggtgctcc tgctcctttg 120
cctttggagt tgcctcactt ctctctcaga gatctcagag ctgctattcc taagcactgc 180
ttcgagagat ctttcgtgac ctccacctac tacatgatca agaacgtgtt gacttgcgct 240
gctttgttat acgctgctac cttcattgat agagctggag ctgctgctta tgttttgtgg 300
cctgtgtact ggttcttcca gggatcttac ttgactggag tgtgggttat cgctcacgag 360
tgtggacacc aggcttattg ctcttctgag gtggtgaaca acttgattgg actcgtgttg 420
cactctgctt tgttggtgcc ttaccactct tggagaatct ctcacagaaa gcaccactcc 480
aacactggat cttgcgagaa cgatgaggtt ttcgttcctg tgaccagatc tgtgttggct 540
tcttcttgga acgagacctt ggaggattct cctctctacc aactctaccg tatcgtgtac 600
atgttggttg ttggatggat gcctggatac ctcttcttca acgctactgg acctactaag 660
tactggggaa agtctaggtc tcacttcaac ccttactccg ctatctatgc tgatagggag 720

aggtggatga tcgtgctctc cgatattttc ttggtggcta tgttggctgt tttggctgct 780
ttggtgcaca ctttctcctt caacacgatg gtgaagttct acgtggtgcc ttacttcatt 840
gtgaacgctt acttggtgtt gattacctac ctccaacaca ccgataccta catccctcac 900
ttcagagagg gagagtggaa ttggttgaga ggagctttgt gcactgtgga tagatcattt 960
ggtccattcc tcgattctgt ggtgcataga atcgtggata cccacgtttg ccaccatatc 1020
ttctccaaga tgcctttcta tcactgcgag gaggctacca acgctattaa gcctctcctc 1080
ggaaagttct acttgaagga tactactcct gttcctgttg ctctctggag atcttacacc 1140
cactgcaagt tcgttgagga tgatggaaag gtggtgttct acaagaacaa gttatag 1197

<210> 325
<211> 398
<212> PRT
<213> Artificial Sequence

<220>
<223> d12Des(Ps) on LBFLFK Locus 1

<400> 325
Met Ala Ile Leu Asn Pro Glu Ala Asp Ser Ala Ala Asn Leu Ala Thr
1   5   10   15
Asp Ser Glu Ala Lys Gln Arg Gln Leu Ala Glu Ala Gly Tyr Thr His
            20   25   30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Glu Leu Pro His Phe Ser
        35   40   45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50   55   60
Phe Val Thr Ser Thr Tyr Tyr Met Ile Lys Asn Val Leu Thr Cys Ala
65   70   75   80
Ala Leu Leu Tyr Ala Ala Thr Phe Ile Asp Arg Ala Gly Ala Ala Ala
                85   90   95
Tyr Val Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100   105   110
Gly Val Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115   120   125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Val Leu Ala Ser Ser Trp Asn Glu Thr Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195   200   205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210   215   220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ala Asp Arg Glu
225   230   235   240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Ala Met Leu Ala
                245   250   255
Val Leu Ala Ala Leu Val His Thr Phe Ser Phe Asn Thr Met Val Lys
            260   265   270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275   280   285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Glu Gly
    290   295   300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Pro Phe Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
                325   330   335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Thr
        355   360   365
Thr Pro Val Pro Val Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Lys Val Val Phe Tyr Lys Asn Lys Leu
385   390   395

<210> 326
<211> 1338
<212> DNA
<213> Artificial Sequence

<220>
<223> d4Des(Pl) on LBFLFK Locus 2

<400> 326
atgccaccta gtgctgctag tgaaggtggt gttgctgaac ttagagctgc tgaagttgct 60
agctacacta gaaaggctgt tgacgaaaga cctgacctca ctatagttgg tgacgctgtt 120
tacgacgcta aggcttttag ggacgagcac cctggtggtg ctcacttcgt tagccttttc 180
ggaggtaggg acgctactga ggcttttatg gaatatcacc gtagagcttg gcctaaggct 240
aggatgtcta agttcttcgt tggttcactt gacgctagcg agaagcctac tcaagctgat 300
tcatcttacc ttagactttg cgctgaggtt aacgctcttt tgcctaaggg tagcggagga 360
ttcgctcctc ctagctactg gcttaaggct gctgctcttg ttgttgctgc tgttagtata 420
gagggttata tgctccttag gggtaagacc cttttgctta gcgttttcct tggactcgtg 480
ttcgcttgga taggacttaa tattcagcac gacgctaatc acggtgctct tagtagacac 540
tcagtgatta actactgcct cggttacgct caggattgga taggtggtaa tatggtgctt 600
tggcttcaag agcacgttgt gatgcaccac ctccacacta acgacgttga cgctgatcct 660
gatcaaaagg ctcacggtgt tcttagactt aagcctactg acggttggat gccttggcac 720
gcacttcaac aactctatat ccttcctggt gaggctatgt acgcttttaa gcttcttttc 780
ttggacgccc ttgagcttct tgcttggagg tgggagggtg agaagattag ccctcttgct 840
agagctttgt tcgctcctgc tgttgcttgt aagcttggat tctgggctag attcgttgct 900
ctccctctct ggcttcaacc tactgttcac actgctttgt gtatctgtgc tactgtgtgt 960
actggtagct tctacctcgc cttcttcttc tttatctctc acaacttcga cggtgttggt 1020
agcgttggac ctaagggatc acttcctaga tcagctactt tcgttcaacg tcaggttgag 1080
actagctcta acgttggtgg ttactggctt ggagttctta acggtggact taactttcag 1140
atagagcacc acttgttccc taggcttcac cactcttact acgctcaaat agctcctgtg 1200
gttaggactc acatagagaa gctcggtttt aagtaccgtc acttccctac cgttggatct 1260
aaccttagct caatgcttca gcatatgggt aagatgggaa ctagacctgg tgctgagaag 1320
ggtggtaagg ctgagtag 1338

<210> 327
<211> 445
<212> PRT
<213> Artificial Sequence

<220>
<223> d4Des(Pl) on LBFLFK Locus 2

<400> 327
Met Pro Pro Ser Ala Ala Ser Glu Gly Gly Val Ala Glu Leu Arg Ala
1   5   10   15
Ala Glu Val Ala Ser Tyr Thr Arg Lys Ala Val Asp Glu Arg Pro Asp
            20   25   30
Leu Thr Ile Val Gly Asp Ala Val Tyr Asp Ala Lys Ala Phe Arg Asp
        35   40   45
Glu His Pro Gly Gly Ala His Phe Val Ser Leu Phe Gly Gly Arg Asp
    50   55   60
Ala Thr Glu Ala Phe Met Glu Tyr His Arg Arg Ala Trp Pro Lys Ala
65   70   75   80
Arg Met Ser Lys Phe Phe Val Gly Ser Leu Asp Ala Ser Glu Lys Pro
                85   90   95
Thr Gln Ala Asp Ser Ser Tyr Leu Arg Leu Cys Ala Glu Val Asn Ala
            100   105   110
Leu Leu Pro Lys Gly Ser Gly Gly Phe Ala Pro Pro Ser Tyr Trp Leu
        115   120   125
Lys Ala Ala Ala Leu Val Val Ala Ala Val Ser Ile Glu Gly Tyr Met
    130   135   140
Leu Leu Arg Gly Lys Thr Leu Leu Leu Ser Val Phe Leu Gly Leu Val
145   150   155   160
Phe Ala Trp Ile Gly Leu Asn Ile Gln His Asp Ala Asn His Gly Ala
                165   170   175
Leu Ser Arg His Ser Val Ile Asn Tyr Cys Leu Gly Tyr Ala Gln Asp
            180   185   190
Trp Ile Gly Gly Asn Met Val Leu Trp Leu Gln Glu His Val Val Met

```
        195                 200                 205
His His Leu His Thr Asn Asp Val Asp Ala Asp Pro Asp Gln Lys Ala
    210                 215                 220
His Gly Val Leu Arg Leu Lys Pro Thr Asp Gly Trp Met Pro Trp His
225                 230                 235                 240
Ala Leu Gln Gln Leu Tyr Ile Leu Pro Gly Glu Ala Met Tyr Ala Phe
                245                 250                 255
Lys Leu Leu Phe Leu Asp Ala Leu Glu Leu Leu Ala Trp Arg Trp Glu
            260                 265                 270
Gly Glu Lys Ile Ser Pro Leu Ala Arg Ala Leu Phe Ala Pro Ala Val
        275                 280                 285
Ala Cys Lys Leu Gly Phe Trp Ala Arg Phe Val Ala Leu Pro Leu Trp
    290                 295                 300
Leu Gln Pro Thr Val His Thr Ala Leu Cys Ile Cys Ala Thr Val Cys
305                 310                 315                 320
Thr Gly Ser Phe Tyr Leu Ala Phe Phe Phe Phe Ile Ser His Asn Phe
                325                 330                 335
Asp Gly Val Gly Ser Val Gly Pro Lys Gly Ser Leu Pro Arg Ser Ala
            340                 345                 350
Thr Phe Val Gln Arg Gln Val Glu Thr Ser Ser Asn Val Gly Gly Tyr
        355                 360                 365
Trp Leu Gly Val Leu Asn Gly Gly Leu Asn Phe Gln Ile Glu His His
    370                 375                 380
Leu Phe Pro Arg Leu His His Ser Tyr Tyr Ala Gln Ile Ala Pro Val
385                 390                 395                 400
Val Arg Thr His Ile Glu Lys Leu Gly Phe Lys Tyr Arg His Phe Pro
                405                 410                 415
Thr Val Gly Ser Asn Leu Ser Ser Met Leu Gln His Met Gly Lys Met
            420                 425                 430
Gly Thr Arg Pro Gly Ala Glu Lys Gly Gly Lys Ala Glu
        435                 440                 445

<210> 328
<211> 398
<212> PRT
<213> Artificial Sequence

<220>
<223> Consensus

<220>
<221> misc_feature
<222> (94)..(94)
<223> Xaa can be any proteinogenic amino acid

<220>
<221> misc_feature
<222> (186)..(186)
<223> Xaa can be any proteinogenic amino acid

<400> 328
Met Ala Ile Leu Asn Pro Glu Ala Glu Ser Ala Ala Lys Val Ala Ser
1               5                   10                  15
Leu Ser Glu Ala Lys Gln Arg Glu Leu Ala Glu Ala Gly Tyr Lys His
            20                  25                  30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Asp Leu Pro His Phe Ser
        35                  40                  45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50                  55                  60
Phe Ile Thr Ser Thr Tyr Tyr Met Ile Lys Asn Leu Leu Thr Cys Ala
65                  70                  75                  80
Ala Leu Phe Tyr Ala Ala Thr Tyr Ile Asp Gln Thr Gly Xaa Phe Ala
                85                  90                  95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100                 105                 110
Gly Ile Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115                 120                 125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
```

    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Val Ile Ala Ser Ser Trp Asp Glu Xaa Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195   200   205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210   215   220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ser Asp Arg Glu
225   230   235   240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Leu Met Ile Gly
                245   250   255
Val Leu Ala Thr Leu Val Tyr Thr Phe Ser Phe Tyr Thr Met Leu Lys
            260   265   270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275   280   285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Asp Ser
    290   295   300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Pro Tyr Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
                325   330   335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Asp
        355   360   365
Thr Pro Val Pro Ile Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Lys Ile Val Phe Tyr Lys Asn Lys Leu
385   390   395

<210> 329
<211> 398
<212> PRT
<213> Phytophthora sojae

<220>
<223> G5A275_PHYSP-Phytophthora_sojae

<400> 329
Met Ala Ile Leu Asn Pro Glu Ala Asp Ser Ala Ala Asn Leu Ala Thr
1   5   10   15
Asp Ser Glu Ala Lys Gln Arg Gln Leu Ala Glu Ala Gly Tyr Thr His
            20   25   30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Glu Leu Pro His Phe Ser
        35   40   45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50   55   60
Phe Val Thr Ser Thr Tyr Tyr Met Ile Lys Asn Val Leu Thr Cys Ala
65   70   75   80
Ala Leu Phe Tyr Ala Ala Thr Phe Ile Asp Arg Ala Gly Ala Ala Ala
                85   90   95
Tyr Val Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100   105   110
Gly Val Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115   120   125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Val Leu Ala Ser Ser Trp Asn Glu Thr Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro

        195   200   205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210   215   220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ala Asp Arg Glu
225   230   235   240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Ala Met Leu Ala
                245   250   255
Val Leu Ala Ala Leu Val His Thr Phe Ser Phe Asn Thr Met Val Lys
            260   265   270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275   280   285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Glu Gly
    290   295   300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Pro Phe Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
                325   330   335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Thr
        355   360   365
Thr Pro Val Pro Val Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Lys Val Val Phe Tyr Lys Asn Lys Leu
385   390   395

<210> 330
<211> 398
<212> PRT
<213> Phytophthora ramorum

<220>
<223> H3G9L1_PHYRM-Phytophthora_ramorum

<400> 330
Met Ala Ile Leu Asn Pro Glu Ala Asp Ser Ala Ala Lys Val Ala Ser
1   5   10   15
Asp Ser Glu Ala Lys Gln Arg Gln Leu Ala Glu Ala Gly Tyr Lys His
            20   25   30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Glu Leu Pro His Phe Ser
        35   40   45
Leu Arg Glu Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50   55   60
Phe Val Thr Ser Thr Tyr Tyr Ala Ile Lys Asn Met Leu Thr Cys Ala
65   70   75   80
Ala Leu Phe Tyr Ala Ala Ser Tyr Ile Asp Gln Thr Gly Ala Ala Ala
                85   90   95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100   105   110
Gly Ile Trp Val Val Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115   120   125
Ser Glu Val Val Asn Asn Ile Ile Gly Leu Val Leu His Ser Ala Leu
    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Val Ala Ala Ser Ser Trp Asp Glu Thr Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195   200   205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210   215   220
Pro Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ser Asp Arg Glu
225   230   235   240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Ile Val Ala Leu Ser
                245   250   255
Thr Leu Ala Val Leu Val His Thr Phe Ser Leu Phe Thr Met Val Lys

            260   265   270
Phe Tyr Val Val Pro Tyr Phe Val Val Asn Ala Tyr Leu Val Leu Ile
        275   280   285
Thr Phe Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Glu Gly
    290   295   300
Glu Trp Ser Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Lys Tyr Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
                325   330   335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Thr
        355   360   365
Thr Pro Val Pro Met Ala Leu Trp Arg Ser Tyr Thr Tyr Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Asn Val Val Phe Tyr Lys Asn Lys Leu
385   390   395

<210> 331
<211> 398
<212> PRT
<213> Phytophthora infestans

<220>
<223> G4XUM4_PHYIN-Phytophthora_infestans

<400> 331
Met Ala Ile Leu Asn Pro Glu Ala Glu Ser Ala Ala Lys Val Ala Thr
1   5   10   15
Leu Ser Glu Ala Lys Gln Arg Glu Leu Ala Glu Ala Gly Tyr Lys His
            20   25   30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Asp Leu Pro His Phe Ser
        35   40   45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50   55   60
Phe Ile Thr Ser Thr Tyr Tyr Met Ile Lys Asn Leu Leu Thr Cys Ala
65   70   75   80
Ala Leu Phe Tyr Ala Ala Thr Tyr Ile Asp Gln Thr Gly Ser Phe Ala
                85   90   95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100   105   110
Gly Ile Trp Val Val Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115   120   125
Ser Glu Val Val Asn Asn Met Ile Gly Leu Val Leu His Ser Thr Leu
    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Val Ile Ala Ser Ser Trp Asp Glu Thr Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195   200   205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Ser Lys Tyr Leu Gly Lys
    210   215   220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ser Ile Tyr Ser Asp Arg Glu
225   230   235   240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Leu Met Ile Gly
                245   250   255
Ala Leu Val Thr Leu Val Tyr Thr Phe Ser Phe Tyr Thr Met Leu Lys
            260   265   270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275   280   285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Asp Ser
    290   295   300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Pro Tyr Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Ile

                325   330   335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Asp
        355   360   365
Thr Pro Val Pro Ile Ala Leu Trp Arg Ser Tyr Ile His Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Lys Ile Val Phe Tyr Lys Asn Lys Leu
385   390   395

<210> 332
<211> 398
<212> PRT
<213> Hyaloperonospora arabidopsidis

<220>
<223> M4BXW8_HYAAE-Hyaloperonospora_arabidopsidis

<400> 332
Met Ala Ile Leu Asn Pro Asp Ser Glu Ser Pro Thr Lys Gln Val Ala
1   5   10   15
Asp Ser Glu Ala Lys Gln Arg Gln Leu Ala Glu Ala Gly Tyr Lys His
            20   25   30
Val Glu Gly Cys Pro Ala Pro Leu Pro Leu Glu Leu Pro His Phe Ser
        35   40   45
Leu Arg Asp Leu Arg Ala Ala Thr Pro Glu His Cys Phe Glu Arg Ser
    50   55   60
Phe Val Thr Ser Met Tyr His Leu Val Lys Asn Leu Leu Tyr Cys Gly
65   70   75   80
Ala Leu Leu Tyr Val Ala Thr Arg Leu Asp Asp Leu Gly Ala Ile Ala
                85   90   95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100   105   110
Gly Val Trp Val Ile Ala His Glu Cys Gly His Gln Ser Phe Cys Ser
        115   120   125
Ser Glu Thr Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Ala Ile Lys Ser Ser Trp Asn Glu Val Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Ala Phe Met Leu Val Val Gly Trp Met Pro
        195   200   205
Gly Tyr Leu Cys Phe Asn Ala Thr Gly Pro Ser Lys Tyr Trp Gly Lys
    210   215   220
Ala Arg Ser His Phe Asn Pro Phe Ser Thr Leu Tyr Ala Asp Arg Glu
225   230   235   240
Arg Trp Leu Ile Val Leu Ser Asp Val Ser Leu Val Leu Val Leu Ala
                245   250   255
Gly Leu Ala Gly Leu Val His Thr Leu Ser Leu Tyr Thr Met Val Lys
            260   265   270
Leu Tyr Phe Ala Pro Tyr Leu Ile Val Asn Val Tyr Leu Val Leu Ile
        275   280   285
Thr Phe Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Glu Gly
    290   295   300
Glu Trp Thr Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Pro Tyr Leu Asp Ser Val Leu His His Ile Val Asp Thr His Val
                325   330   335
Val His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Lys Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Thr
        355   360   365
Thr Pro Phe Pro Leu Ala Met Trp Arg Ser Tyr Lys His Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Lys Ile Val Phe Tyr Lys Asn Lys Leu

385 390 395

<210> 333
<211> 398
<212> PRT
<213> Phytophthora parasitica

<220>
<223> W2PDL4_PHYPN-Phytophthora_parasitica

<400> 333
Met Ala Ile Leu Asn Pro Glu Ala Glu Ser Ala Ala Lys Val Ala Ser
1 5 10 15
Leu Ser Glu Ala Lys Gln Arg Glu Leu Ala Glu Ala Gly Tyr Lys His
20 25 30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Asp Leu Pro His Phe Ser
35 40 45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
50 55 60
Phe Ile Thr Ser Thr Tyr Tyr Met Ile Lys Asn Leu Leu Thr Cys Ala
65 70 75 80
Ala Leu Phe Tyr Ala Ala Thr Tyr Ile Asp Gln Thr Gly Asn Phe Ala
85 90 95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
100 105 110
Gly Ile Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
115 120 125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
130 135 140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145 150 155 160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
165 170 175
Ser Val Ile Ala Ser Ser Trp Asp Glu Asn Leu Glu Asp Ser Pro Leu
180 185 190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
195 200 205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
210 215 220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ser Asp Arg Glu
225 230 235 240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Leu Val Ile Gly
245 250 255
Val Leu Ala Thr Leu Val Tyr Thr Phe Ser Phe Tyr Thr Met Leu Lys
260 265 270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
275 280 285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Asp Ser
290 295 300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305 310 315 320
Gly Pro Tyr Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
325 330 335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
340 345 350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Asp
355 360 365
Thr Pro Val Pro Ile Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
370 375 380
Val Glu Asp Asp Gly Lys Ile Val Phe Tyr Lys Asn Lys Leu
385 390 395

<210> 334
<211> 398
<212> PRT
<213> Phytophthora parasitica

<220>

<223> W2LW72_PHYPR-Phytophthora_parasitica

<400> 334
Met Ala Ile Leu Asn Pro Glu Ala Glu Ser Ala Ala Lys Val Ala Ser
1   5   10   15
Leu Ser Glu Ala Lys Gln Arg Glu Leu Ala Glu Ala Gly Tyr Lys His
            20   25   30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Asp Leu Pro His Phe Ser
        35   40   45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50   55   60
Phe Ile Thr Ser Thr Tyr Tyr Met Ile Lys Asn Leu Leu Thr Cys Ala
65   70   75   80
Ala Leu Phe Tyr Ala Ala Thr Tyr Ile Asp Gln Thr Gly Asn Phe Ala
                85   90   95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100   105   110
Gly Ile Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115   120   125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
    130   135   140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145   150   155   160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165   170   175
Ser Val Ile Ala Ser Ser Trp Asp Glu Asn Leu Glu Asp Ser Pro Leu
            180   185   190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195   200   205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210   215   220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ser Asp Arg Glu
225   230   235   240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Leu Met Ile Gly
                245   250   255
Val Leu Ala Thr Leu Val Tyr Thr Phe Ser Phe Tyr Thr Met Leu Lys
            260   265   270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275   280   285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Asp Ser
    290   295   300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305   310   315   320
Gly Pro Tyr Leu Asp Leu Val Val His Arg Ile Val Asp Thr His Val
                325   330   335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340   345   350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Asp
        355   360   365
Thr Pro Val Pro Ile Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
    370   375   380
Val Glu Asp Asp Gly Lys Ile Val Phe Tyr Lys Asn Lys Leu
385   390   395

<210> 335
<211> 398
<212> PRT
<213> Phytophthora parasitica

<220>
<223> W2ZYI2_PHYPR-Phytophthora_parasitica

<400> 335
Met Ala Ile Leu Asn Pro Glu Ala Glu Ser Ala Ala Lys Val Ala Ser
1   5   10   15
Leu Ser Glu Ala Lys Gln Arg Glu Leu Ala Glu Ala Gly Tyr Lys His
            20   25   30
Val Glu Gly Ala Pro Ala Pro Leu Pro Leu Asp Leu Pro His Phe Ser

```
        35                  40                  45
Leu Arg Asp Leu Arg Ala Ala Ile Pro Lys His Cys Phe Glu Arg Ser
    50                  55                  60
Phe Ile Thr Ser Thr Tyr Tyr Met Ile Lys Asn Leu Leu Thr Cys Ala
65                  70                  75                  80
Ala Leu Phe Tyr Ala Ala Thr Tyr Ile Asp Gln Thr Gly Asn Phe Thr
                85                  90                  95
Tyr Leu Leu Trp Pro Val Tyr Trp Phe Phe Gln Gly Ser Tyr Leu Thr
            100                 105                 110
Gly Ile Trp Val Ile Ala His Glu Cys Gly His Gln Ala Tyr Cys Ser
        115                 120                 125
Ser Glu Val Val Asn Asn Leu Ile Gly Leu Val Leu His Ser Ala Leu
    130                 135                 140
Leu Val Pro Tyr His Ser Trp Arg Ile Ser His Arg Lys His His Ser
145                 150                 155                 160
Asn Thr Gly Ser Cys Glu Asn Asp Glu Val Phe Val Pro Val Thr Arg
                165                 170                 175
Ser Val Ile Ala Ser Ser Trp Asp Glu Asn Leu Glu Asp Ser Pro Leu
            180                 185                 190
Tyr Gln Leu Tyr Arg Ile Val Tyr Met Leu Val Val Gly Trp Met Pro
        195                 200                 205
Gly Tyr Leu Phe Phe Asn Ala Thr Gly Pro Thr Lys Tyr Trp Gly Lys
    210                 215                 220
Ser Arg Ser His Phe Asn Pro Tyr Ser Ala Ile Tyr Ser Asp Arg Glu
225                 230                 235                 240
Arg Trp Met Ile Val Leu Ser Asp Ile Phe Leu Val Leu Met Ile Gly
                245                 250                 255
Val Leu Ala Thr Leu Val Tyr Thr Phe Ser Phe Tyr Thr Met Leu Lys
            260                 265                 270
Phe Tyr Val Val Pro Tyr Phe Ile Val Asn Ala Tyr Leu Val Leu Ile
        275                 280                 285
Thr Tyr Leu Gln His Thr Asp Thr Tyr Ile Pro His Phe Arg Asp Ser
    290                 295                 300
Glu Trp Asn Trp Leu Arg Gly Ala Leu Cys Thr Val Asp Arg Ser Phe
305                 310                 315                 320
Gly Pro Tyr Leu Asp Ser Val Val His Arg Ile Val Asp Thr His Val
                325                 330                 335
Cys His His Ile Phe Ser Lys Met Pro Phe Tyr His Cys Glu Glu Ala
            340                 345                 350
Thr Asn Ala Ile Lys Pro Leu Leu Gly Lys Phe Tyr Leu Lys Asp Asp
        355                 360                 365
Thr Pro Val Pro Ile Ala Leu Trp Arg Ser Tyr Thr His Cys Lys Phe
    370                 375                 380
Val Glu Asp Asp Gly Lys Ile Val Phe Tyr Lys Asn Lys Leu
385                 390                 395

<210> 336
<211> 393
<212> PRT
<213> Saprolegnia spp.

<220>
<223> Q6UB74_9STRA-Saprolegnia

<400> 336
Met Cys Lys Gly Gln Ala Pro Ser Lys Ala Asp Val Phe His Ala Ala
1               5                   10                  15
Gly Tyr Arg Pro Val Ala Gly Thr Pro Glu Pro Leu Pro Leu Glu Pro
            20                  25                  30
Pro Thr Ile Thr Leu Lys Asp Leu Arg Ala Ala Ile Pro Ala His Cys
        35                  40                  45
Phe Glu Arg Ser Ala Ala Thr Ser Phe Tyr His Leu Ala Lys Asn Leu
    50                  55                  60
Ala Ile Cys Ala Gly Val Phe Ala Val Gly Leu Lys Leu Ala Ala Ala
65                  70                  75                  80
Asp Leu Pro Leu Ala Ala Lys Leu Val Ala Trp Pro Ile Tyr Trp Phe
                85                  90                  95
Val Gln Gly Thr Tyr Phe Thr Gly Ile Trp Val Ile Ala His Glu Cys
```

```
                100                     105                     110
Gly His Gln Ala Phe Ser Ala Ser Glu Ile Leu Asn Asp Thr Val Gly
        115                     120                     125
Ile Ile Leu His Ser Leu Leu Phe Val Pro Tyr His Ser Trp Lys Ile
    130                     135                     140
Thr His Arg Arg His His Ser Asn Thr Gly Ser Cys Glu Asn Asp Glu
145                     150                     155                     160
Val Phe Thr Pro Thr Pro Arg Ser Val Val Glu Ala Lys His Asp His
                165                     170                     175
Ser Leu Leu Glu Glu Ser Pro Leu Tyr Asn Leu Tyr Gly Ile Val Met
            180                     185                     190
Met Leu Leu Val Gly Trp Met Pro Gly Tyr Leu Phe Phe Asn Ala Thr
        195                     200                     205
Gly Pro Thr Lys Tyr Ala Gly Leu Ala Lys Ser His Phe Asn Pro Tyr
    210                     215                     220
Ala Ala Phe Phe Leu Pro Lys Glu Arg Leu Ser Ile Trp Trp Ser Asp
225                     230                     235                     240
Leu Cys Phe Leu Ala Ala Leu Tyr Gly Phe Gly Tyr Gly Val Ser Val
                245                     250                     255
Phe Gly Leu Leu Asp Val Ala Arg His Tyr Ile Val Pro Tyr Leu Ile
            260                     265                     270
Cys Asn Ala Tyr Leu Val Leu Ile Thr Tyr Leu Gln His Thr Asp Thr
        275                     280                     285
Tyr Val Pro His Phe Arg Gly Asp Glu Trp Asn Trp Leu Arg Gly Ala
    290                     295                     300
Leu Cys Thr Val Asp Arg Ser Phe Gly Ala Trp Ile Asp Ser Ala Ile
305                     310                     315                     320
His His Ile Ala Asp Thr His Val Thr His His Ile Phe Ser Lys Thr
                325                     330                     335
Pro Phe Tyr His Ala Ile Glu Ala Thr Asp Ala Ile Thr Pro Leu Leu
            340                     345                     350
Gly Lys Tyr Tyr Leu Ile Asp Pro Thr Pro Ile Pro Leu Ala Leu Trp
        355                     360                     365
Arg Ser Phe Thr His Cys Lys Tyr Val Glu Asp Asp Gly Asn Val Val
    370                     375                     380
Phe Tyr Lys Arg Lys Leu Glu Glu Lys
385                     390
```